



ARIB STD-T94

OFDMA Broadband Mobile Wireless  
Access System  
(WiMAX™ applied in Japan)

ARIB STANDARD

ARIB STD-T94 Version 2.2

|             |           |      |      |
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| Version 2.1 | March     | 28th | 2011 |
| Version 2.2 | July      | 7th  | 2011 |

Association of Radio Industries and Businesses

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## Preface

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## INTRODUCTION

6 Association of Radio Industries and Businesses (hereinafter ARIB) investigates and  
7 summarizes the basic technical requirements for various radio systems in the form of “technical  
8 standard (ARIB STD)”. These standards are being developed with the participation of, and  
9 through discussions amongst various radio equipment manufacturers, operators and users.

10 ARIB standards include “government technical standards” (mandatory standards) that are  
11 set for the purpose of encouraging effective use of frequency resources and preventing  
12 interference, and “private technical standards” (voluntary standards) that are defined in order  
13 to guarantee compatibility between radio facilities, to secure adequate transmission quality as  
14 well as to offer greater convenience to radio equipment manufacturers and users, etc.

15 An ARIB STANDARD herein is published as "OFDMA Broadband Mobile Wireless Access  
16 System (WiMAX™ applied in Japan)". In order to ensure fairness and transparency in the  
17 defining stage, the standard was set by consensus of the standard council with participation of  
18 interested parties including radio equipment manufacturers, telecommunications operators,  
19 broadcasters, testing organizations, general users, etc. with impartiality.

20

21 ARIB sincerely hopes that this standard be utilized actively by radio equipment  
22 manufacturers, telecommunications operators, and users, etc.

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## INDUSTRIAL PROPERTY RIGHTS (IPRs)

Although this ARIB Standard contains no specific reference to any Essential Industrial Property Rights relating thereto, the holders of such Essential Industrial Property Rights state to the effect that the rights listed in Attachment 1 and 2, which are the Industrial Property Rights relating to this standard, are held by the parties also listed therein, and that to the users of this standard, in the case of Attachment 1 (selection of option 1), such holders shall not assert any rights and shall unconditionally grant a license to practice such Industrial Property Rights contained therein, and in the case of Attachment 2 (selection of option 2), the holders shall grant, under the reasonable terms and conditions, a non-exclusive and non-discriminatory license to practice the Industrial Property Rights contained therein. However, this does not apply to anyone who uses this ARIB Standard and also owns and lays claim to any other Essential Industrial Property Rights of which is covered in whole or part in the contents of provisions of this ARIB Standard.

### List of Essential Industrial Property Rights (IPRs)

The lists of Essential Industrial Property Rights (IPRs) are shown in the following Attachments.

- Attachment 1      List of Essential Industrial Property Rights (selection of option 1)
- Attachment 2      List of Essential Industrial Property Rights (selection of option 2)
- Reference          This is the list of Essential Industrial Property Rights (IPRs) filed or applied to countries other than Japan. These are listed here as a reference, as the companies voluntarily informed ARIB of these IPRs.

## Contents

|    |   |    |
|----|---|----|
| 1  |   |    |
| 2  | Preface   |    |
| 3  | INTRODUCTION  |    |
| 4  | INDUSTRIAL PROPERTY RIGHTS (IPRs)                                   |    |
| 5  | List of Essential Industrial Property Rights (IPRs)                 |    |
| 6  |   |    |
| 7  | Chapter 1 General Descriptions .....                                | 1  |
| 8  | 1.1 Outline.....  | 1  |
| 9  | 1.2 Scope of the Standard.....                                      | 1  |
| 10 | 1.3 Reference Regulations .....                                     | 2  |
| 11 | 1.4 Reference Documents .....                                       | 2  |
| 12 | Chapter 2 System overview .....                                     | 3  |
| 13 | 2.1 Mobile WiMAX Network Architecture .....                         | 4  |
| 14 | 2.1.1 Architecture Principles .....                                 | 4  |
| 15 | 2.2 WiMAX Network Reference Model .....                             | 6  |
| 16 | 2.3 Physical Layer Description.....                                 | 11 |
| 17 | 2.3.1 OFDMA Basics .....  | 11 |
| 18 | 2.3.2 OFDMA Symbol Structure and Subchannelization.....             | 13 |
| 19 | 2.3.3 Scalable OFDMA.....   | 16 |
| 20 | 2.3.4 TDD Frame Structure.....                                      | 16 |
| 21 | 2.3.5 Other Advanced PHY Layer Features.....                        | 18 |
| 22 | 2.4 MAC Layer Description.....                                      | 22 |
| 23 | 2.4.1 Quality of Service (QoS) Support.....                         | 23 |
| 24 | 2.4.2 MAC Scheduling Service.....                                   | 24 |
| 25 | 2.4.3 Power control and boosting.....                               | 26 |
| 26 | 2.4.4 Mobility Management .....                                     | 26 |
| 27 | 2.4.5 Power Management.....   | 26 |
| 28 | 2.4.6 Handover .....  | 27 |
| 29 | 2.4.7 Security.....   | 27 |
| 30 | 2.5 Enhancements in the WiMAX Forum System Profile Release 1.5..... | 28 |
| 31 | 2.6 Low Power Repeater .....  | 29 |
| 32 | 2.6.1 Outline .....   | 29 |
| 33 | 2.6.2 Configuration.....  | 29 |

|    |           |  |    |
|----|-----------|--|----|
| 1  | Chapter 3 | Technical Requirements for WiMAX Systems           | 30 |
| 2  | 3.1       | Overview   | 30 |
| 3  | 3.2       | General condition                                  | 30 |
| 4  | 3.2.1     | Transmitter requirement for Mobile WiMAX equipment | 35 |
| 5  | 3.2.1.1   | Frequency tolerance (ORE, Article 5, Table 1)      | 35 |
| 6  | 3.2.1.2   | Occupied band width (ORE, Article 6, Table 2)      | 35 |
| 7  | 3.2.1.3   | Output power (ORE, Article 49.28)                  | 35 |
| 8  | 3.2.1.4   | Output power tolerance (ORE, Article 14)           | 35 |
| 9  | 3.2.1.5   | Adjacent channel leakage power (NT No.651,2007)    | 35 |
| 10 | 3.2.1.6   | Spectrum mask (NT No.651, 2007)                    | 36 |
| 11 | 3.2.1.7   | Spurious emission (NT No.651,2007)                 | 37 |
| 12 | 3.2.1.8   | Intermodulation (NT No.651, 2007)                  | 38 |
| 13 | 3.2.1.9   | Standby output power (ORE, Article 49.28)          | 38 |
| 14 | 3.2.1.10  | Antenna gain (ORE, Article 49.28)                  | 38 |
| 15 | 3.2.1.11  | Cabinet radiation                                  | 38 |
| 16 | 3.2.2     | Receiver requirement for Mobile WiMAX equipment    | 38 |
| 17 | 3.2.2.1   | Reception sensitivity                              | 38 |
| 18 | 3.2.2.2   | Spurious response rejection ratio                  | 39 |
| 19 | 3.2.2.3   | Adjacent signal selectivity                        | 39 |
| 20 | 3.2.2.4   | Intermodulation performance                        | 40 |
| 21 | 3.2.2.5   | Conducted Spurious (ORE, Article 24)               | 40 |
| 22 | 3.2.3     | Transmitter requirement for FWA equipment          | 40 |
| 23 | 3.2.3.1   | Frequency tolerance (ORE, Article 5, Table 1)      | 40 |
| 24 | 3.2.3.2   | Occupied band width (ORE, Article 6, Table 2)      | 40 |
| 25 | 3.2.3.3   | Output power (ORE, Article 49.28)                  | 41 |
| 26 | 3.2.3.4   | Output power tolerance (ORE, Article 14)           | 41 |
| 27 | 3.2.3.5   | Adjacent channel leakage power (NT No.651, 2007)   | 41 |
| 28 | 3.2.3.6   | Spectrum mask (NT No.651,2007)                     | 42 |
| 29 | 3.2.3.7   | Spurious emission (NT No.651, 2007)                | 43 |
| 30 | 3.2.3.8   | Intermodulation (NT No.651,2007)                   | 44 |
| 31 | 3.2.3.9   | Standby output power (ORE, Article 49.28)          | 44 |
| 32 | 3.2.3.10  | Antenna gain (ORE, Article 49.28)                  | 44 |
| 33 | 3.2.3.11  | Cabinet radiation                                  | 44 |
| 34 | 3.2.4     | Receiver requirement for FWA equipment             | 45 |
| 35 | 3.2.4.1   | Reception sensitivity                              | 45 |

|    |           |   |    |
|----|-----------|---|----|
| 1  | 3.2.4.2   | Conducted Spurious (ORE, Article 24) .....                            | 45 |
| 2  | 3.3       | Low Power Repeater .....  | 46 |
| 3  | 3.3.1     | General Condition .....   | 46 |
| 4  | 3.3.1.1   | System condition.....   | 48 |
| 5  | 3.3.2     | Transmitter Requirement for Low Power Repeater .....                  | 48 |
| 6  | 3.3.2.1   | Frequency tolerance (ORE, Article 5, Table1) .....                    | 48 |
| 7  | 3.3.2.2   | Occupied band width (ORE, Article 6, Table 2) .....                   | 48 |
| 8  | 3.3.2.3   | Output power (ORE, Article 49.28) .....                               | 48 |
| 9  | 3.3.2.4   | Output power tolerance (ORE, Article 14).....                         | 49 |
| 10 | 3.3.2.5   | Adjacent channel leakage power (NT No.651, 2007).....                 | 49 |
| 11 | 3.3.2.6   | Spectrum mask (NT No.651, 2007) .....                                 | 50 |
| 12 | 3.3.2.7   | Spurious emission (NT No.651, 2007).....                              | 50 |
| 13 | 3.3.2.8   | Standby output power (ORE,Article 49.28) .....                        | 51 |
| 14 | 3.3.2.9   | Antenna gain (ORE,Article 49.28) .....                                | 51 |
| 15 | 3.3.2.10  | Cabinet radiation.....  | 52 |
| 16 | 3.3.2.11  | Out of band gain (ORE Article 49.28) .....                            | 52 |
| 17 | 3.3.2.12  | Intermodulation (NT No.651, 2007).....                                | 52 |
| 18 | 3.3.3     | Receiver Requirement for Low Power Repeaters.....                     | 52 |
| 19 | 3.3.3.1   | Reception sensitivity (in case of Regenerative repeating type) .....  | 52 |
| 20 | 3.3.3.2   | Spurious response rejection ratio.....                                | 53 |
| 21 | 3.3.3.3   | Adjacent signal selectivity.....                                      | 53 |
| 22 | 3.3.3.4   | Intermodulation performance .....                                     | 54 |
| 23 | 3.3.3.5   | Conducted Spurious (ORE, Article 24) .....                            | 54 |
| 24 | 3.3.3.6   | Requirements for Blanket License Application.....                     | 54 |
| 25 | 3.3.3.7   | Requirements for Interference Avoidance to Other Radio Stations ..... | 54 |
| 26 | Chapter 4 | System Profile .....  | 55 |
| 27 | 4.1       | Release 1.0.....  | 55 |
| 28 | 4.2       | Release 1.5.....  | 55 |
| 29 | Chapter 5 | Network Architecture .....  | 56 |
| 30 | 5.1       | Release 1.0.....  | 56 |
| 31 | 5.2       | Release 1.5.....  | 57 |
| 32 | Chapter 6 | Measurement Method.....   | 60 |

|    |                  |  |
|----|------------------|--|
| 1  | Attachment       |  |
| 2  | Attachment 1     | List of Essential Industrial Property Rights (Selection of Option 1) |
| 3  | Attachment 2     | List of Essential Industrial Property Rights (Selection of Option 2) |
| 4  | Reference        | Reference (Not Applied in Japan)                                     |
| 5  | - Release 1.0 -  |  |
| 6  | Attachment 3-1   | WiMAX Forum™ Mobile System Profile Release 1.0 v1.40                 |
| 7  | - Release 1.5 -  |  |
| 8  | Attachment 3-2-1 | WiMAX Forum™ Mobile System Profile Release 1.5 Common Part           |
| 9  | Attachment 3-2-2 | WiMAX Forum™ Mobile System Profile Release 1.5 TDD Part              |
| 10 | - Release 1.0 -  |  |
| 11 | Attachment 4-1-1 | End-to-End Network Systems Architecture                              |
| 12 |                  | WiMAX Forum Network Architecture                                     |
| 13 |                  | (Stage 2: Architecture Tenets, Reference Model and Reference Points) |
| 14 |                  | [Stage 2 and Stage 3 Abbreviations]                                  |
| 15 |                  | Release 1.1.0  |
| 16 | Attachment 4-1-2 | End-to-End Network Systems Architecture                              |
| 17 |                  | WiMAX Forum Network Architecture                                     |
| 18 |                  | (Stage 2: Architecture Tenets, Reference Model and Reference Points) |
| 19 |                  | [Part 0]   |
| 20 |                  | Release 1.1.0  |
| 21 | Attachment 4-1-3 | End-to-End Network Systems Architecture                              |
| 22 |                  | WiMAX Forum Network Architecture                                     |
| 23 |                  | (Stage 2: Architecture Tenets, Reference Model and Reference Points) |
| 24 |                  | [Part 1]   |
| 25 |                  | Release 1.1.0  |
| 26 | Attachment 4-1-4 | End-to-End Network Systems Architecture                              |
| 27 |                  | WiMAX Forum Network Architecture                                     |

|    |  |
|----|--|
| 1  | (Stage 2: Architecture Tenets, Reference Model and Reference Points) |
| 2  | [Part 2]   |
| 3  | Release 1.1.0  |
| 4  | Attachment 4-1-5 End-to-End Network Systems Architecture             |
| 5  | WiMAX Forum Network Architecture                                     |
| 6  | (Stage 2: Architecture Tenets, Reference Model and Reference Points) |
| 7  | [Part 3 – Informative Annex]   |
| 8  | Release 1.1.0  |
| 9  | Attachment 4-1-6 End-to-End Network Systems Architecture             |
| 10 | WiMAX Forum Network Architecture                                     |
| 11 | (Stage 2: Architecture Tenets, Reference Model and Reference Points) |
| 12 | [WiMAX Interworking with DSL]  |
| 13 | Release 1.1.0  |
| 14 | Attachment 4-1-7 End-to-End Network Systems Architecture             |
| 15 | WiMAX Forum Network Architecture                                     |
| 16 | (Stage 2: Architecture Tenets, Reference Model and Reference Points) |
| 17 | [3GPP – WiMAX Interworking]  |
| 18 | Release 1.1.0  |
| 19 | Attachment 4-1-8 End-to-End Network Systems Architecture             |
| 20 | WiMAX Forum Network Architecture                                     |
| 21 | (Stage 2: Architecture Tenets, Reference Model and Reference Points) |
| 22 | [3GPP2 – WiMAX Interworking]   |
| 23 | Release 1.1.0  |
| 24 | Attachment 4-1-9 End-to-End Network Systems Architecture             |
| 25 | WiMAX Forum Network Architecture                                     |
| 26 | (Stage 3: Detailed Protocols and Procedures)                         |
| 27 | Release 1.1.0  |
| 28 | Attachment 4-1-10 End-to-End Network Systems Architecture            |
| 29 | WiMAX Forum Network Architecture                                     |
| 30 | (Stage 3: Detailed Protocols and Procedures)                         |
| 31 | [Annex: WiMAX - 3GPP Interworking]                                   |

- 1 Release 1.1.0
- 2 Attachment 4-1-11 End-to-End Network Systems Architecture  
3 WiMAX Forum Network Architecture  
4 (Stage 3: Detailed Protocols and Procedures)  
5 [Annex: WiMAX - 3GPP2 Interworking]  
6 Release 1.1.0
- 7 Attachment 4-1-12 End-to-End Network Systems Architecture  
8 WiMAX Forum Network Architecture  
9 (Stage 3: Detailed Protocols and Procedures)  
10 [Annex: Prepaid Accounting]  
11 Release 1.1.0
- 12 Attachment 4-1-13 End-to-End Network Systems Architecture  
13 WiMAX Forum Network Architecture  
14 (Stage 3: Detailed Protocols and Procedures)  
15 [Annex: R6/R8 ASN Anchored Mobility Scenarios]  
16 Release 1.1.0
- 17 - Release 1.5 -
- 18 Attachment 4-2-1 WiMAX Forum® Network Architecture  
19 Detailed Protocols and Procedures  
20 Base Specification  
21 WMF-T33-001-R015v01
- 22 Attachment 4-2-2 WiMAX Forum® Network Architecture  
23 Detailed Protocols and Procedures  
24 [Informative Annex: Hooks and Principles for Evolution]  
25 WMF-T33-004-R015v01
- 26 Attachment 4-2-3 WiMAX Forum® Network Architecture  
27 Architecture, detailed Protocols and Procedures  
28 IP Multimedia Subsystem (IMS) Interworking  
29 WMF-T33-101-R015v01
- 30 Attachment 4-2-4 WiMAX Forum® Network Architecture

|    |   |
|----|---|
| 1  | Architecture, detailed Protocols and Procedures                       |
| 2  | Emergency Services Support  |
| 3  | WMF-T33-102-R015v02   |
| 4  | Attachment 4-2-5 WiMAX Forum® Network Architecture                    |
| 5  | Architecture, detailed Protocols and Procedures                       |
| 6  | WiMAX Over-The-Air General Provisioning System Specification          |
| 7  | WMF-T33-103-R015v02   |
| 8  | Attachment 4-2-6 WiMAX Forum® Network Architecture                    |
| 9  | Architecture, detailed Protocols and Procedures                       |
| 10 | WiMAX Over-The-Air Provisioning & Activation Protocol based on OMA DM |
| 11 | Specifications  |
| 12 | WMF-T33-104-R015v02   |
| 13 | Attachment 4-2-7 WiMAX Forum® Network Architecture                    |
| 14 | Architecture, detailed Protocols and Procedures                       |
| 15 | Over-The-Air Provisioning & Activation Protocol based on TR-069       |
| 16 | Specification   |
| 17 | WMF-T33-105-R015v01   |
| 18 | Attachment 4-2-8 WiMAX Forum® Network Architecture                    |
| 19 | Architecture, detailed Protocols and Procedures                       |
| 20 | WIMAX Lawful Intercept - NORTH AMERICAN REGION                        |
| 21 | WMF-T33-107-R015v01   |
| 22 | Attachment 4-2-9 WiMAX Forum® Network Architecture                    |
| 23 | Architecture, detailed Protocols and Procedures                       |
| 24 | Robust Header Compression (RoHC) Support                              |
| 25 | WMF-T33-108-R015v01   |
| 26 | Attachment 4-2-10 WiMAX Forum® Network Architecture                   |
| 27 | Architecture, detailed Protocols and Procedures                       |
| 28 | Policy and Charging Control   |
| 29 | WMF-T33-109-R015v01   |
| 30 | Attachment 4-2-11 WiMAX Forum® Network Architecture                   |

|    |  |
|----|--|
| 1  | Protocols and Procedures for Location Based Services                   |
| 2  | WMF-T33-110-R015v01  |
| 3  | Attachment 4-2-12 WiMAX Forum® Network Architecture                    |
| 4  | System Requirements, Network Protocols and Architecture for Multi-cast |
| 5  | Broad-cast Services  |
| 6  | (MCBCS Subteams Common Sections)                                       |
| 7  | WMF-T33-111-R015v01  |
| 8  | Attachment 4-2-13 WiMAX Forum® Network Architecture                    |
| 9  | System Requirements, Network Protocols and Architecture for Multi-cast |
| 10 | Broad-cast Services  |
| 11 | Dynamic Service Flow Based (MCBCS – DSx)                               |
| 12 | WMF-T33-112-R015v01  |
| 13 | Attachment 4-2-14 WiMAX Forum® Network Architecture                    |
| 14 | System Requirements, Network Protocols and Architecture for Multi-cast |
| 15 | Broad-cast Services  |
| 16 | (MCBCS Application Layer Approach)                                     |
| 17 | WMF-T33-113-R015v01  |
| 18 | Attachment 4-2-15 WiMAX Forum® Network Architecture                    |
| 19 | Architecture, detailed Protocols and Procedures                        |
| 20 | WiMAX-SIM Application on UICC  |
| 21 | WMF-T33-114-R015v01  |
| 22 | Attachment 4-2-16 WiMAX Forum® Network Architecture                    |
| 23 | Universal Services Interface (USI)                                     |
| 24 | An Architecture for Internet+ Service Model                            |
| 25 | WMF-T33-115-R015v01  |
| 26 |  |
| 27 | Change History   |
| 28 |  |

## Chapter 1 General Descriptions

### 1.1 Outline

This standard specifies requirements of the radio equipment of radio stations stipulated in the Ministry of Internal Affairs and Communications (MIC) Ordinance Regulating Radio Equipment, Article 49.28 (this refers to the radio equipment of radio stations of OFDMA Broadband Mobile Wireless Access System) using 2.5 GHz band with 5 ms of transmission burst repetition period. It also specifies the radio communication for OFDMA Broadband Mobile Wireless Access System using 2.5 GHz band with 5 ms of transmission burst repetition period (hereinafter referred to as “Mobile WiMAX™ System”) defined as the technology for personal wireless broadband services based on all-IP core network.

The standard shall be in accordance with MIC Ordinance Regulating Radio Equipment, Article 49.28 (including related notifications) when the Mobile WiMAX facilities are used in Japan. The system shall also conform to the WiMAX™ mobile System Profile and the WiMAX End-to-End Network Systems Architecture specified by WiMAX Forum®. It should be noted that the mobile System Profile refers to IEEE802.16 for the specifications of physical layer and MAC layer.

### 1.2 Scope of the Standard

The Mobile WiMAX network consists of Mobile Station (MS), Access Service Network (ASN) and Connectivity Service Network (CSN), and the scope of the standard is shown in Figure 1-1.

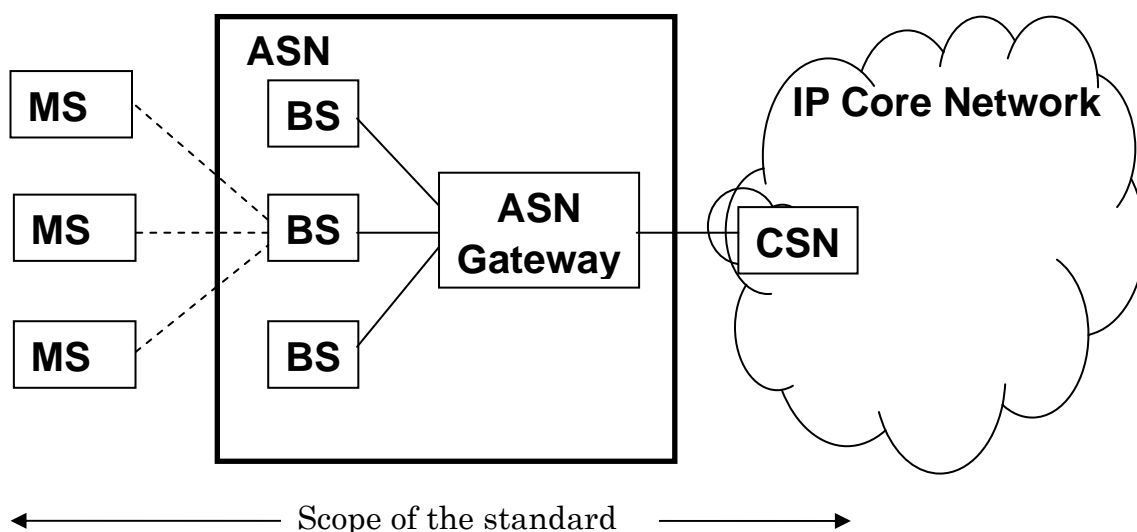


Figure 1-1 Configuration of Mobile WiMAX Network

1 MS is used by the end users to access the network. ASN comprises Base Stations (BS) and  
2 ASN gateways. BS is responsible for providing the air interface to the MS, while ASN gateway  
3 typically acts as layer 2 traffic aggregation within an ASN. CSN provides IP connectivity and all  
4 IP core network functions.

5 This standard defines the minimum level of specifications required for connection and  
6 services for the Mobile WiMAX system. This consists of three different specifications, i.e.,  
7 Japanese regulatory specifications applied for radio systems, Physical and MAC layers  
8 specifications and Upper layers specifications. The Japanese regulatory specifications are  
9 developed by national regulatory administration, i.e. MIC. The physical and MAC layers  
10 specifications and the Upper layers specifications are developed by international  
11 standardization organization, i.e. IEEE802.16 Working Group and WiMAX Forum, respectively.

12 This standard is intended to combine the national regulations and the international  
13 specifications, however in case of inconsistency between them, the national regulations shall  
14 prevail. The national regulations are the mandatory requirements for operation of the Mobile  
15 WiMAX in Japan.

16 The physical layer and MAC layer specifications are produced by IEEE802.16 Working Group  
17 in two documents, IEEE802.16-2004 and IEEE802.16e-2005. These documents offer a variety of  
18 fundamentally different design options in the physical layer and the MAC layer. For practical  
19 reasons of interoperability, WiMAX Forum defined a limited number of system profiles from  
20 these documents as summarized in the WiMAX mobile system profile.

21 Since IEEE802.16-2004 and IEEE802.16e-2005 specifications do not define the end-to-end  
22 WiMAX network, WiMAX Forum has developed a network reference model called End-to-End  
23 Network Systems Architecture as the architecture framework for WiMAX deployment and to  
24 insure interoperability among various WiMAX equipment and operators.

25

### 26 1.3 Reference Regulations

27 The acronyms of the referenced regulations used in this standard are as follows;

28 ORE : Ordinance Regulating Radio Equipment

29 NT: Notification of the Ministry of Posts and Telecommunications if issued in 2000 or earlier,  
30 and a Notification of the Ministry of Internal Affairs and Communications if issued in  
31 2001 or later

32

### 33 1.4 Reference Documents

34 - WiMAX Forum Mobile System Profile

35 - WiMAX End-to-End Network Systems Architecture

## Chapter 2 System overview

1

2

3 The IEEE802.16 Working Group develops and supports the IEEE802.16 air interface  
4 standard for Broadband Wireless Access systems. The amendment IEEE Std 802.16e-2005  
5 along with the base IEEE Std 802.16-2004 provides the basis for the Mobile WiMAX air  
6 interface for combined fixed and mobile broadband wireless access.

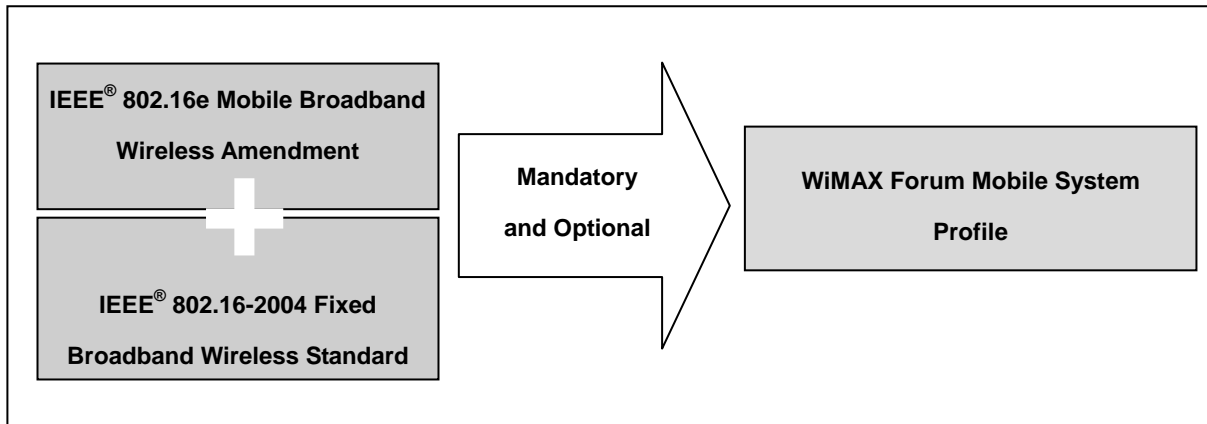
7 IEEE Std 802.16 offers a flexible set of parameters and features to meet a range of global  
8 requirements. Due to this flexibility, interoperability with respect to the required features needs  
9 to be ensured. Interoperability testing is a key function of the WiMAX Forum. Therefore, the  
10 WiMAX Forum has developed profiles specifying particular features and parameter sets based  
11 on IEEE 802.16 in order to ensure interoperability.

12 The Mobile WiMAX RTT (Radio Transmission Technology) is consistent with the WiMAX  
13 Forum Mobile System Profile being commercialized by members of WiMAX Forum under the  
14 name “Mobile WiMAX™”. The WiMAX Forum Mobile System Profile as illustrated in Figure  
15 2-1 is derived from the mandatory and optional feature sets described in IEEE Std 802.16. This  
16 profile is used for air interface certification to foster global interoperability. WiMAX Forum  
17 Mobile profiles include recommended 5 and 10 MHz bandwidth, aligned with Mobile WiMAX  
18 proposal, for global deployment.

19 The WiMAX Form Mobile System Profile Release 1.0 was first issued with the basic  
20 functionalities to meet the global deployment. Since then WiMAX Forum has been developing  
21 additional features to the Release 1.0 over time.

22 The WiMAX Forum Mobile System Profile Release 1.5 was issued with additional functions,  
23 such as FDD mode of operation and the enhancement of the system performance.

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**Figure 2-1 WiMAX Forum Mobile System Profile**

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5 The WiMAX Mobile System Profile supports the deployment of fully interoperable systems  
 6 compatible with Mobile WiMAX. The profile includes optional Base Station features providing  
 7 flexibility for various deployment scenarios and regional requirements to enable optimization  
 8 for capacity, coverage, etc.<sup>1</sup>

9

## 10 2.1 Mobile WiMAX Network Architecture

11 The Mobile WiMAX radio interface is suitable for use in an all-IP (Internet Protocol)  
 12 architecture, with support for IP-based packet services. This allows for scalability and rapid  
 13 deployment since the networking functionality is primarily based on software services.

14 In order to deploy successful and operational commercial systems, there is need for support  
 15 beyond the IEEE802.16 air interface specifications, which only address layers 1 and 2 (PHY  
 16 (Physical) and MAC (Media Access Control) layers). The WiMAX Forum specifies the Mobile  
 17 WiMAX Network Architecture describing the upper layer of the Radio Access Network and Core  
 18 Network. Furthermore, the systems can also operate with core network of other IMT-2000  
 19 systems.

20

### 21 2.1.1 Architecture Principles

22 The following basic principles have guided the Mobile WiMAX Network Architecture  
 23 development.

- 24 1. The architecture is based on a packet-switched framework, including native procedures  
 25 based on IEEE Std 802.16, appropriate IETF (Internet Engineering Task Force) RFCs

<sup>1</sup> Mobile WiMAX – Part I: A Technical Overview and Performance Evaluation.  
[http://www.wimaxforum.org/technology/downloads/Mobile\\_WiMAX\\_Part1\\_Overview\\_and\\_Performance.pdf](http://www.wimaxforum.org/technology/downloads/Mobile_WiMAX_Part1_Overview_and_Performance.pdf)

1 (Request For Comments) and Ethernet standards.

- 2 2. The architecture permits decoupling of access architecture (and supported topologies) from  
3 connectivity IP service. Network elements of the connectivity system are independent of  
4 the IEEE802.16 radio specifics.
- 5 3. The architecture allows modularity and flexibility to accommodate a broad range of  
6 deployment options such as:
- 7 • Small-scale to large-scale (sparse to dense radio coverage and capacity) networks
  - 8 • Urban, suburban, and rural radio propagation environments
  - 9 • Licensed and/or license-exempt frequency bands
  - 10 • Hierarchical, flat, or mesh topologies, and their variants
  - 11 • Co-existence of fixed, nomadic, portable and mobile usage models

12

13 Support for Services and Applications: The End-to-End Mobile WiMAX Network Architecture  
14 includes a) Support of voice, multimedia services and other mandated regulatory services such  
15 as emergency services and lawful interception, b) Access to a variety of independent ASP  
16 (Application Service Provider) networks in a neutral manner, c) Mobile telephony  
17 communications using VoIP, d) Support interfacing with various interworking and media  
18 gateways permitting delivery of incumbent/legacy services translated over IP (for example, SMS  
19 (Short Message Service) over IP, MMS (Multimedia Message Service) , WAP (Wireless  
20 Application Protocol) ) to WiMAX access networks and e) Support delivery of IP Broadcast and  
21 Multicast services over WiMAX access networks.

22 Interworking and Roaming is another key strength of the End-to-End Mobile WiMAX  
23 Network Architecture with support for a number of deployment scenarios. In particular, there  
24 will be support of a) Loosely-coupled interworking with existing wireless networks such as those  
25 specified in 3GPP (3G Partnership Project) and 3GPP2 (3G Partnership Project 2) or existing  
26 wireline networks such as DSL (Digital Subscriber Line) and MSO (Multi Service Operator),  
27 with the interworking interface(s) based on a standard IETF suite of protocols, b) Global  
28 roaming across WiMAX operator networks, including support for credential reuse, consistent  
29 use of AAA (Authentication, Authorization, Accounting) for accounting and billing, and  
30 consolidated/common billing and settlement, c) A variety of user authentication credential  
31 formats such as subscriber identify modules (SIM/USIM (Subscriber Identity Module/Universal  
32 Subscriber Identity Module), R-UIM (Removable User Identity Module)), username/password,  
33 digital certificates.

34

## 1 2.2 WiMAX Network Reference Model

2 IEEE Std 802.16 specifies a radio interface but not the network in which it is to be used,  
3 instead leaving an open interface to higher network layers. The WiMAX Forum specifies the  
4 NRM (Network Reference Model) to describe a practical and functional network making use of  
5 the Mobile WiMAX air interface. This NRM is described here because it serves as a framework  
6 for evaluating the performance of the Mobile WiMAX radio interface.

7 The NRM is a logical representation of the network architecture. The NRM identifies  
8 functional entities and reference points over which interoperability is achieved between  
9 functional entities. The architecture has been developed with the objective of providing unified  
10 support of functionality needed in a range of network deployment models and usage scenarios  
11 (ranging from nomadicity to full mobility).

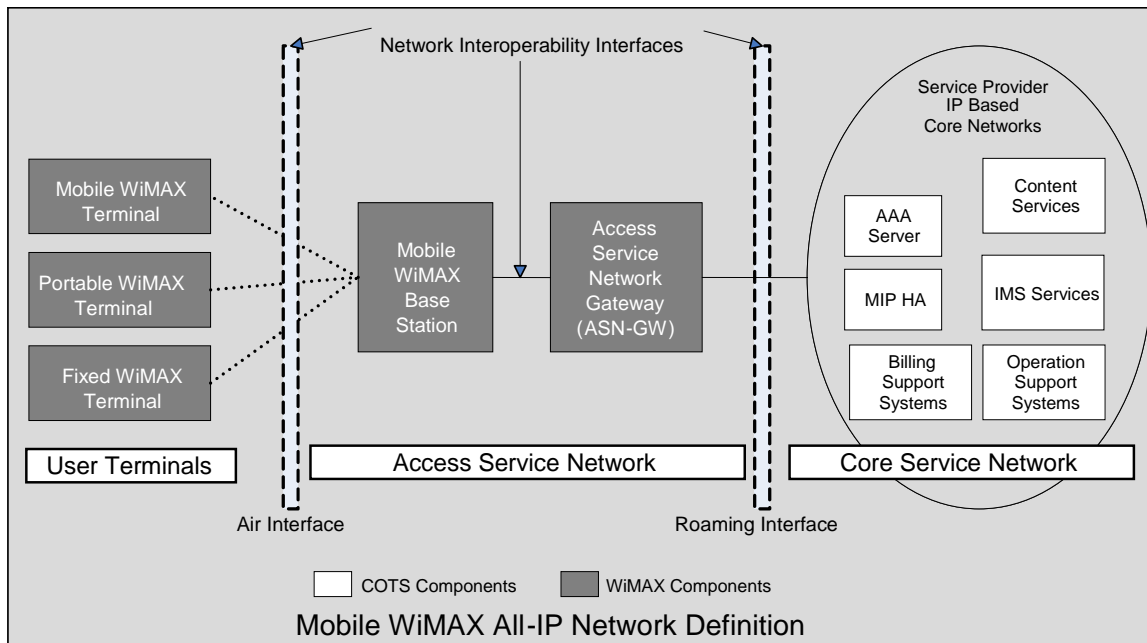
12 Figure 2-2 illustrates the NRM, consisting of the logical entities MS, ASN, and CSN, as well  
13 as clearly identified reference points for interconnection of the logical entities. The figure  
14 depicts the key normative reference points R1-R5. Each of the entities, MS, ASN and CSN,  
15 represents a grouping of functional entities. Each of these functional entities may be realized in  
16 a single physical device or may be distributed over multiple physical devices according to  
17 allocation defined by ASN profiles<sup>2</sup>.

18 The intent of the NRM is to allow multiple implementation options for a given functional  
19 entity, and yet achieve interoperability among different realizations of functional entities.  
20 Interoperability is based on the definition of communication protocols and data plane treatment  
21 between functional entities to achieve an overall end-to-end function, for example, security or  
22 mobility management. Thus, the functional entities on either side of a reference point represent  
23 a collection of control and bearer plane end-points.

---

<sup>2</sup> An ASN profile represents an allocation of functional entities (e.g. authenticator, radio resource manager, etc.) to the various elements belonging to the access network.





1

2

**Figure 2-3 ASN and CSN Entities**

3

4 Some general tenets have guided the development of the Network Architecture and include  
5 the following: a) Logical separation of IP addressing, routing and connectivity management  
6 procedures and protocols, to enable use of the access architecture primitives in standalone and  
7 interworking deployment scenarios, b) Support for sharing of ASN(s) of a NAP (Network Access  
8 Provider) among multiple NSPs, c) Support of a single NSP (Network Service Provider)  
9 providing service over multiple ASN(s) – managed by one or more NAPs, d) Support for the  
10 discovery and selection of accessible NSPs by an MS, e) Support of NAPs that employ one or  
11 more ASN topologies, f) Support of access to incumbent operator services through  
12 internetworking functions as needed, g) Specification of open and well-defined reference points  
13 between various groups of network functional entities (within an ASN, between ASNs, between  
14 an ASN and a CSN, and between CSNs), and in particular between an MS, ASN and CSN to  
15 enable multi-vendor interoperability, h) Support for evolution paths between the various usage  
16 models subject to reasonable technical assumptions and constraints, i) Enabling different  
17 vendor implementations based on different combinations of functional entities on physical  
18 network entities, as long as these implementations comply with the normative protocols and  
19 procedures across applicable reference points, as defined in the network specifications and j)  
20 Support for the most basic scenario of a single operator deploying an ASN together with a  
21 limited set of CSN functions, so that the operator can offer basic Internet access service without  
22 consideration for roaming or interworking.

1

2 The Mobile WiMAX architecture also supports IP services, in a standard mobile IP compliant  
3 network. The flexibility and interoperability supported by this network architecture provides  
4 operators with the opportunity for a multi-vendor implementation of a network even with a  
5 mixed deployment of distributed and centralized ASNs in the network. The Mobile WiMAX  
6 network architecture has the following major features:

#### 7 Security

8 The End-to-End Network Architecture is based upon a security framework that is  
9 independent of the ASN topology and applies consistently across both new and internetworking  
10 deployment models and various usage scenarios. In particular, it supports: a) Strong mutual  
11 device authentication between an MS and the network, based on the IEEE802.16 security  
12 framework, b) All commonly deployed authentication mechanisms and authentication in home  
13 and visited operator network scenarios based on a consistent and extensible authentication  
14 framework, c) Data integrity, replay protection, confidentiality and non-repudiation using  
15 applicable key lengths, d) Use of MS initiated/terminated security mechanisms such as VPNs  
16 (Virtual Private Networks), and e) Standard secure IP address management mechanisms  
17 between the MS and its home or visited NSP.

#### 18 Mobility and Handovers

19 The End-to-End Network Architecture has extensive capabilities to support mobility and  
20 handovers. It a) supports IPv4 or IPv6 based mobility management. Within this framework, and  
21 as applicable, the architecture accommodates MS equipment with multiple IP addresses and  
22 simultaneous IPv4 and IPv6 connections, b) supports roaming between NSPs, c) utilizes  
23 mechanisms to support seamless handovers at up to vehicular speeds— satisfying well-defined  
24 bounds of service disruption. Some of the additional capabilities for mobility include the support  
25 of: i) dynamic and static home address configurations, ii) dynamic assignment of the Home  
26 Agent in the service provider network as a form of route optimization, as well as in the home IP  
27 network as a form of load balancing and iii) dynamic assignment of the Home Agent based on  
28 policies.

#### 29 Scalability, Extensibility, Coverage and Operator Selection

30 The End-to-End Network Architecture has extensive support for scalable, extensible  
31 operation and flexibility in operator selection. In particular, it a) enables a user to manually  
32 or automatically select from available NAPs and NSPs, b) enables ASN and CSN system  
33 designs that easily scale upward and downward – in terms of coverage, range or capacity, c)

1 accommodates a variety of ASN topologies - including hub-and-spoke, hierarchical, and/or  
2 multi-hop interconnects, d) accommodates a variety of backhaul links, both wireline and  
3 wireless with different latency and throughput characteristics, e) supports incremental  
4 infrastructure deployment, f) supports phased introduction of IP services that in turn scale with  
5 increasing number of active users and concurrent IP services per user, g) supports the  
6 integration of BSs of varying coverage and capacity - for example, pico, micro, and macro BSs  
7 and e) supports flexible decomposition and integration of ASN functions in ASN deployments  
8 in order to enable use of load balancing schemes for efficient use of radio spectrum and network  
9 resources.

10 Additional features pertaining to manageability and performance of the Network  
11 Architecture include: a) Support for a variety of online and offline client provisioning,  
12 enrollment, and management schemes based on open, broadly deployable, IP-based, industry  
13 standards, b) Accommodation of OTA (Over-The-Air) services for MS terminal provisioning and  
14 software upgrades, and c) Accommodation of the use of header compression/suppression and/or  
15 payload compression for efficient use of the radio resources.

#### 16 Multi-Vendor Interoperability

17 Another key aspect of the Network Architecture is the support of interoperability between  
18 equipment from different manufacturers within an ASN and across ASNs. This includes  
19 interoperability between: a) BS and backhaul equipment within an ASN, and b) Various ASN  
20 elements (possibly from different vendors) and CSN, with minimal or no degradation in  
21 functionality or capability of the ASN.

#### 22 Quality of Service

23 The Network Architecture has provisions for support of the QoS (Quality Of Service)  
24 mechanisms defined in IEEE Std 802.16. In particular, it enables flexible support of  
25 simultaneous use of a diverse set of IP services. The architecture supports: a) differentiated  
26 levels of QoS, coarse-grained (per user/terminal) and/or fine-grained (per service flow), b)  
27 admission control, c) bandwidth management and d) implementation of policies as defined by  
28 various operators for QoS based on their SLAs (Service Level Agreement) (including policy  
29 enforcement per user and user group as well as factors such as location, time of day, etc.).  
30 Extensive use is made of standard IETF mechanisms for managing policy definition and policy  
31 enforcement between operators.

#### 32 Interworking with Other Networks

33 The Network Architecture supports loosely coupled interworking with existing wireless or

1 wireline core networks such as GSM/GPRS (Global System for Mobile Communications/General  
2 Packet Radio Service), UMTS (Universal Mobile Telecommunications System), HSDPA (High  
3 Speed Downlink Packet Access), CDMA2000 (Code Division Multiple Access 2000), RLAN  
4 (Remote Local Area Network), DSL, and cable modem operator networks on the basis of the  
5 IP/IETF suite of protocols.

6

## 7 2.3 Physical Layer Description

### 8 2.3.1 OFDMA Basics

9 OFDM (Orthogonal Frequency Division Multiplexing) is a multiplexing technique that  
10 subdivides the bandwidth into multiple frequency sub-carriers as shown in Figure 2-4. In an  
11 OFDM system, the input data stream is divided into several parallel sub-streams of reduced  
12 data rate (thus increased symbol duration) and each sub-stream is modulated and transmitted  
13 on a separate orthogonal sub-carrier. The increased symbol duration improves the robustness of  
14 OFDM to delay spread. Furthermore, the introduction of the CP (cyclic prefix) can completely  
15 eliminate ISI (Inter-Symbol Interference) as long as the CP duration is longer than the channel  
16 delay spread. The CP is typically a repetition of the last samples of data portion of the block that  
17 is appended to the beginning of the data payload as shown in Figure 2-5. The CP prevents  
18 inter-block interference and makes the channel appear circular and permits low-complexity  
19 frequency domain equalization. A perceived drawback of CP is that it introduces overhead,  
20 which effectively reduces bandwidth efficiency. While the CP does reduce bandwidth efficiency  
21 somewhat, the impact of the CP is similar to the “roll-off factor” in raised-cosine filtered  
22 single-carrier systems. Since OFDM signal power spectrum has a very sharp fall off at the edge  
23 of channel, a larger fraction of the allocated channel bandwidth can be utilized for data  
24 transmission, which helps to moderate the loss in efficiency due to the cyclic prefix.

25

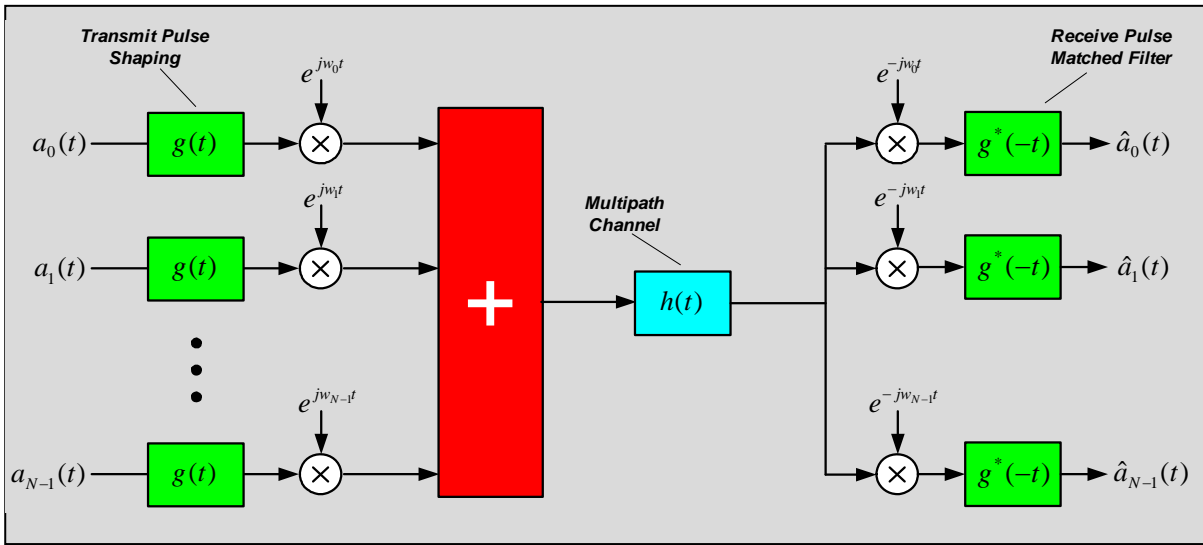
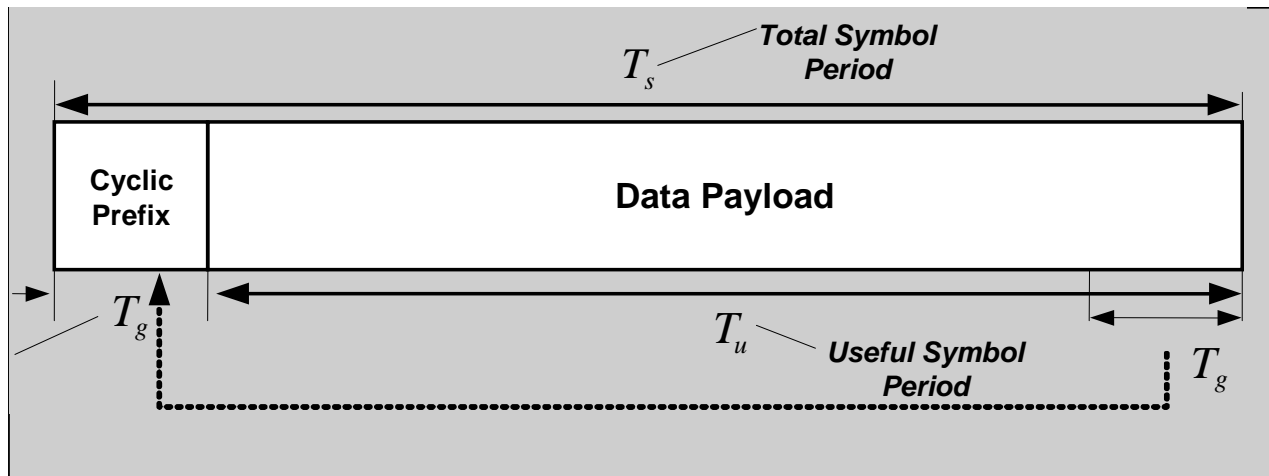


Figure 2-4 Basic Architecture of an OFDM System

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13

OFDM exploits the frequency diversity of the multipath channel by coding and interleaving the information across the sub-carriers prior to transmissions. OFDM modulation can be realized with efficient IFFT (Inverse Fast Fourier Transform), which enables a large number of sub-carriers with low complexity. In an OFDM system, resources are available in the time domain by means of OFDM symbols and in the frequency domain by means of sub-carriers. The time and frequency resources can be organized into subchannels for allocation to individual users. OFDMA (Orthogonal Frequency Division Multiple Access) is a multiple-access/multiplexing scheme that provides multiplexing operation of data streams corresponding to multiple users onto the downlink subchannels. It also supports multiple access of various users by means of uplink subchannels.

1



2

3 **Figure 2-5 Insertion of Cyclic Prefix (CP)**

4

5 **2.3.2 OFDMA Symbol Structure and Subchannelization**

6 The OFDMA symbol structure consists of three types of sub-carriers as shown in Figure 2- 6.

7

8

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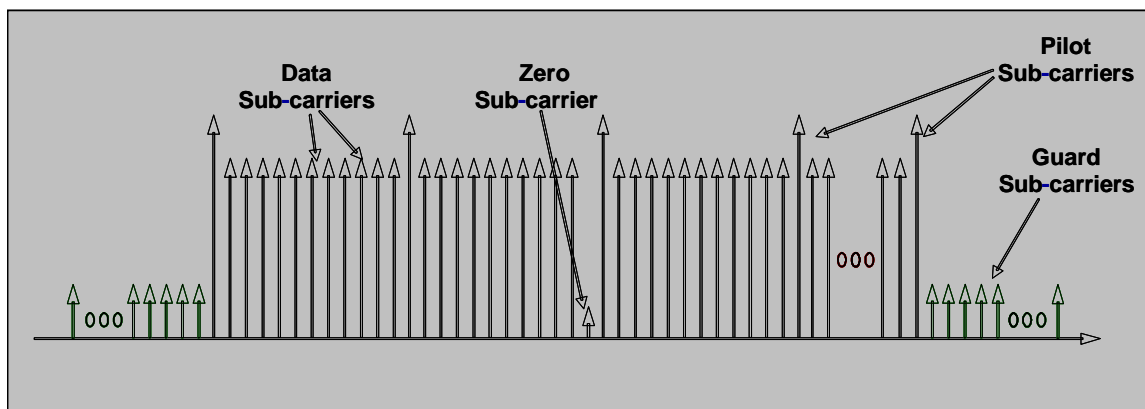
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16 **Figure 2-6 OFDMA Sub-Carrier Structure**

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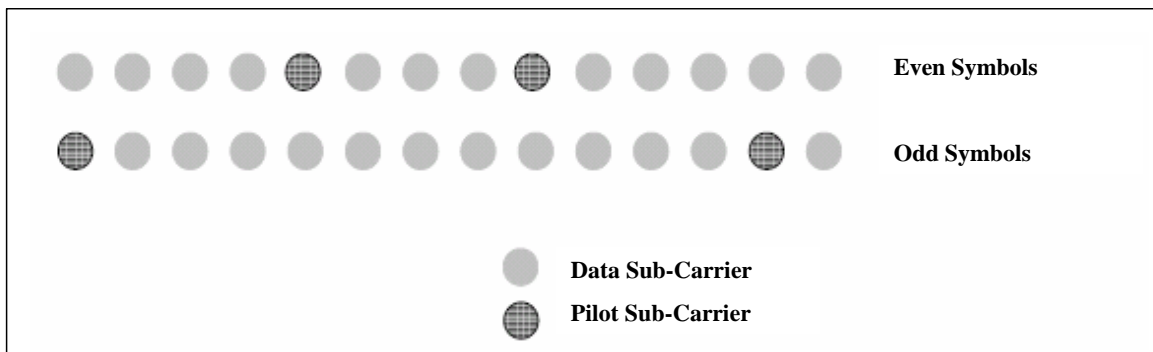
- Data sub-carriers for data transmission.
- Pilot sub-carriers for estimation and synchronization purposes.
- Null sub-carriers for no transmission; used for guard band and zero Hertz sub-carriers.

Active (data and pilot) sub-carriers are grouped into subsets of sub-carriers called subchannels. The Mobile WiMAX PHY supports subchannelization in both DL (Down Link) and UL (Up Link). The minimum frequency-time resource unit of subchannelization is one slot, which is equal to 48 data tones (sub-carriers).

There are two types of sub-carrier permutations for subchannelization; diversity and

1 contiguous. The diversity permutation draws sub-carriers pseudo-randomly to form a  
 2 subchannel. It provides frequency diversity and inter-cell interference averaging. The  
 3 diversity permutations include DL FUSC (Fully Used Subchannelization), DL PUSC (Partially  
 4 Used Subchannelization) and UL PUSC and additional optional permutations. With DL PUSC,  
 5 for each pair of OFDM symbols, the available or usable sub-carriers are grouped into clusters  
 6 containing 14 contiguous sub-carriers per symbol, with pilot and data allocations in each cluster  
 7 in the even and odd symbols as shown in Figure 2- 7.

8



9

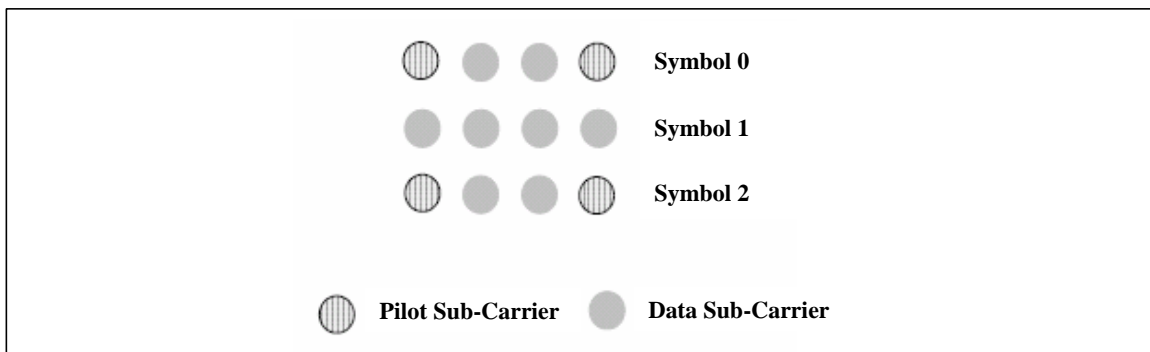
**Figure 2-7 DL Frequency Diverse Subchannel**

10

11 A re-arranging scheme is used to form groups of clusters such that each group is made up of  
 12 clusters that are distributed throughout the sub-carrier space. A subchannel in a group contains  
 13 two (2) clusters and is comprised of 48 data sub-carriers and eight (8) pilot sub-carriers. The  
 14 data subcarriers in each group are further permuted to generate subchannels in the group.  
 15 Therefore, only the pilot positions in the cluster as shown in Figure 2- 7. The data subcarriers in  
 16 the cluster are distributed to multiple subchannels.

17 Analogous to the cluster structure for DL, a tile structure is defined for the UL PUSC whose  
 18 format is shown in Figure 2-8.

19



20

**Figure 2-8 Tile Structure for UL PUSC**

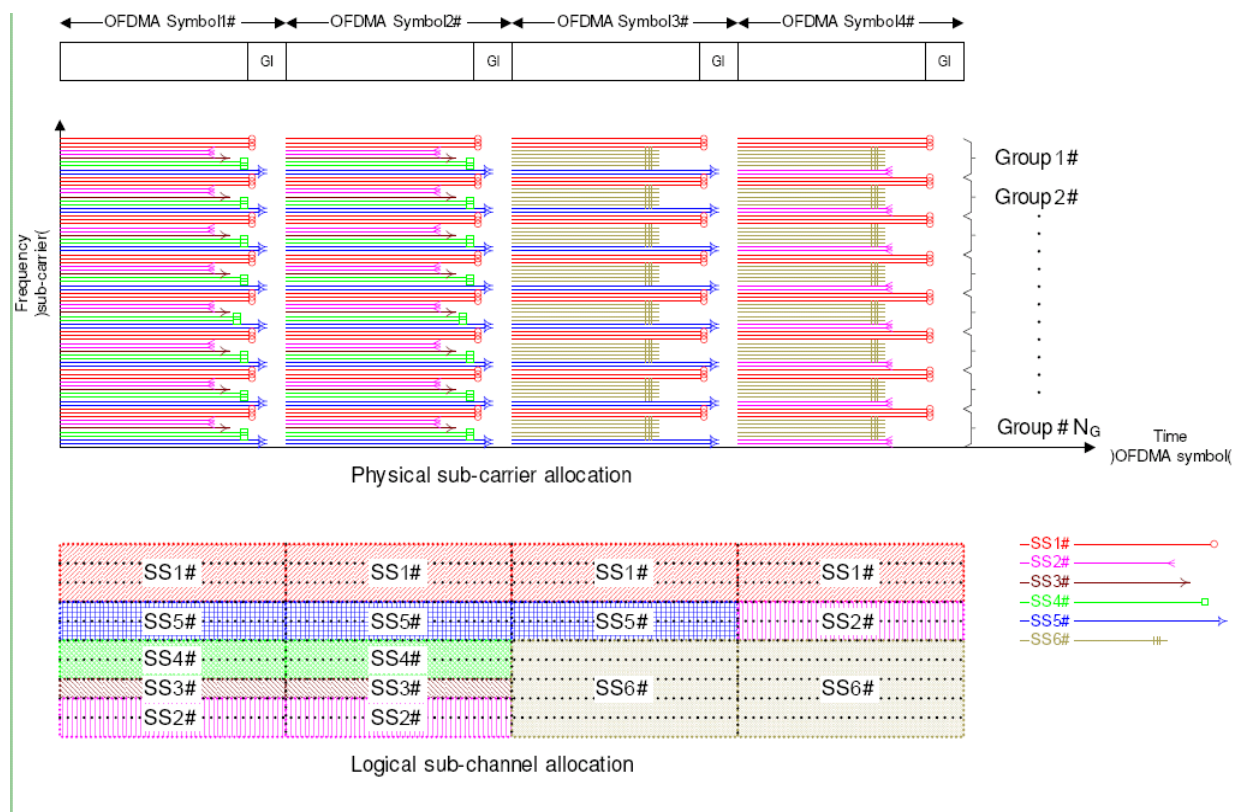
21

1 The available sub-carrier space is split into tiles and six (6) tiles, chosen from across the  
 2 entire spectrum by means of a re-arranging/permutation scheme, are grouped together to form a  
 3 slot. The slot is comprised of 48 data sub-carriers and 24 pilot sub-carriers in 3 OFDM symbols.

4 The contiguous permutation groups a block of contiguous sub-carriers to form a subchannel.  
 5 The contiguous permutations include DL AMC (Adaptive Modulation and Coding) and UL AMC,  
 6 and have the same structure. A bin consists of 9 contiguous sub-carriers in a symbol, with 8  
 7 assigned for data and one assigned for a pilot. A slot in AMC is defined as a collection of bins of  
 8 the type  $(N \times M = 6)$ , where  $N$  is the number of contiguous bins and  $M$  is the number of  
 9 contiguous symbols. Thus the allowed combinations are (6 bins, 1 symbol), (3 bins, 2 symbols), (2  
 10 bins, 3 symbols) or (1 bin, 6 symbols). AMC permutation enables multi-user diversity by  
 11 choosing the subchannel with the best frequency response.

12 In general, diversity sub-carrier permutations perform well in mobile applications while  
 13 contiguous sub-carrier permutations are well suited for fixed, nomadic, or low mobility  
 14 environments. These options enable the system designer to trade-off mobility for throughput.

15 Following figure demonstrates the physical and Logical subchannel allocation in a OFDMA  
 16 frame.



17

18

**Figure 2-9 Physical and Logical Subchannel Allocation**

19

1    2.3.3 Scalable OFDMA

2    Mobile WiMAX mode is based upon the concept of Scalable OFDMA. The scalability is  
 3 supported by adjusting the FFT (Fast Fourier Transform) size while fixing the sub-carrier  
 4 frequency spacing at 10.94 kHz. Since the resource unit sub-carrier bandwidth and symbol  
 5 duration is fixed, the impact to higher layers is minimal when scaling the bandwidth. The  
 6 Mobile WiMAX parameters are listed in Table 2-1.

7

8

**Table 2-1 OFDMA Scalability Parameters**

| Parameters                                  | Values  |      |
|---|---|------|
| System Channel Bandwidth (MHz)              | 5   | 10   |
| Sampling Frequency ( $F_p$ in MHz)          | 5.6   | 11.2 |
| FFT Size ( $N_{FFT}$ )                      | 512   | 1024 |
| Number of Subchannels                       | 8   | 16   |
| Sub-Carrier Frequency Spacing               | 10.94 kHz                                     |      |
| Useful Symbol Time ( $T_b = 1/f$ )          | 91.4 $\mu$ s                                  |      |
| Guard Time ( $T_g = T_b/8$ )                | 11.4 $\mu$ s                                  |      |
| OFDMA Symbol Duration ( $T_s = T_b + T_g$ ) | 102.9 $\mu$ s                                 |      |
| Number of OFDMA Symbols (5 ms Frame)        | 48 (including $\sim 1.6$ symbols for TTG/RTG) |      |

9

10    2.3.4 TDD Frame Structure

11    The Mobile WiMAX PHY makes use of TDD (Time Division Duplexing). To counter  
 12 interference issues, TDD does require system-wide synchronization; nevertheless, TDD has  
 13 numerous advantages:

- 14    • TDD enables adjustment of the downlink/uplink ratio to efficiently support asymmetric  
 15       downlink/uplink traffic, while with FDD (Frequency Division Duplexing), downlink and  
 16       uplink always have fixed and, generally, equal DL and UL bandwidths. As shown in Table  
 17       2-2, recommended number of UL/DL OFDM symbols can flexibly realize a range of  
 18       asymmetric downlink/uplink traffic ratio.

19

20

1

**Table 2-2 Number of OFDM Symbols in DL and UL**

| Description   | Base Station Values  |
|---|--|
| Number of OFDM Symbols in DL and UL for 5 and 10 MHz BW | (35: 12), (34: 13), (33: 14), (32: 15), (31: 16), (30: 17), (29: 18), (28: 19), (27: 20), (26: 21) |

2

- 3 • TDD assures channel reciprocity for better support of link adaptation, MIMO and other
- 4 closed loop advanced antenna technologies. Also, TDD is the preferred mode of operation
- 5 with respect to the beamforming systems using phased array antennas.
- 6 • Unlike FDD, which requires a pair of channels, TDD only requires a single channel for both
- 7 downlink and uplink, providing greater flexibility for adaptation to varied global spectrum
- 8 allocations.
- 9 • Transceiver designs for TDD implementations are less complex.

10 Figure 2-10 illustrates the OFDM frame structure for a TDD implementation. Each frame is  
 11 divided into DL and UL sub-frames, separated by Transmit/Receive and Receive/Transmit  
 12 Transition Gaps (TTG and RTG, respectively) to prevent DL and UL transmission collisions. In  
 13 a frame, the following control information is used:

- 14 • Preamble: The preamble, used for synchronization, is the first OFDM symbol of the frame.
- 15 • FCH (Frame Control Header): The FCH follows the preamble. It provides the frame
- 16 configuration information, such as MAP message length, coding scheme, and usable
- 17 subchannels.
- 18 • DL-MAP (Down Link Map) and UL-MAP (Up Link Map): The DL-MAP and UL-MAP
- 19 provide subchannel allocation and other control information for the DL and UL sub-frames
- 20 respectively.
- 21 • UL Ranging: The UL ranging subchannel is allocated for MSs to perform closed-loop time,
- 22 frequency, and power adjustment as well as bandwidth requests. Four types of ranging are
- 23 defined. The different types of ranging are identified by a code and a 2D region in the UL
- 24 subframe.
  - 25 ○ Initial Ranging- when MS enters (or re-enters) the network,
  - 26 ○ Periodic Ranging once the connection is set up between the MS and the BS,
  - 27 ○ Hand Over Ranging (in case of Hard HO in drop situations), and
  - 28 ○ Bandwidth Request.

- 1 • UL CQICH (Up Link Channel Quality Indication Channel): The UL CQICH channel is
- 2 allocated for the MS to feedback channel-state information.
- 3 • UL ACK (Up Link Acknowledge): The UL ACK is allocated for the MS to feedback DL
- 4 HARQ (Hybrid Automatic Repeat Request) acknowledgement.
- 5

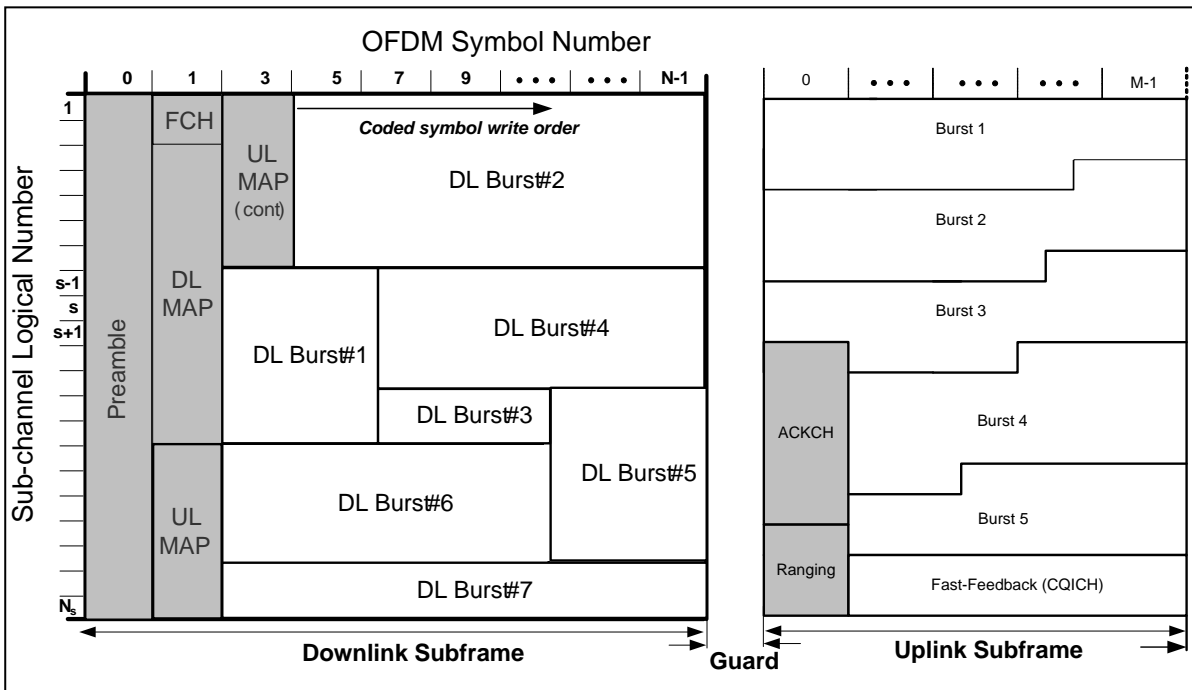


Figure 2-10 Mobile WiMAX Frame Structure

### 2.3.5 Other Advanced PHY Layer Features

Adaptive modulation and coding, HARQ, CQICH, and multiple antenna technologies provide enhanced coverage and capacity in mobile applications.

Support for QPSK (Quadrature Phase Shift Keying), 16QAM (Quadrature Amplitude Modulation) and 64QAM are mandatory in the DL. In the UL, 64QAM is optional. Both CC (Convolutional Code) and CTC (Convolutional Turbo Code), with variable code rate and repetition coding, are supported. Table 2-3 summarizes the coding and modulation schemes supported in Mobile WiMAX.

1

**Table 2-3 Supported Coding and Modulation Schemes**

|            |            | DL                 | UL                            |
|------------|------------|--------------------|-------------------------------|
| Modulation |            | QPSK, 16QAM, 64QAM | QPSK, 16QAM, (64QAM optional) |
| Rate       | CC         | 1/2, 2/3, 3/4, 5/6 | 1/2, 2/3, (5/6 optional)      |
|            | CTC        | 1/2, 2/3, 3/4, 5/6 | 1/2, 2/3, (5/6 optional)      |
|            | Repetition | x2, x4, x6         | x2, x4, x6                    |

2

3 The numerology of WiMAX PHY with the system bandwidth of 5 MHz and 10 MHz is shown  
4 in Table 2-4. Table 2-5 assumes PUSC subchannels with frame duration of 5 milliseconds. Each  
5 frame has 48 OFDM symbols, with 44 OFDM symbols available for data transmission. The  
6 highlighted values indicate data rates for optional 64QAM in the UL.

7

8

**Table 2-4 Mobile WiMAX PHY Numerology**

| Parameter            | Downlink                                | Uplink | Downlink | Uplink |
|----------------------|---|--------|----------|--------|
| System Bandwidth     | 5 MHz                                   |        | 10 MHz   |        |
| FFT Size             | 512                                     |        | 1024     |        |
| Null Sub-Carriers    | 92                                      | 104    | 184      | 184    |
| Pilot Sub-Carriers   | 60                                      | 136    | 120      | 280    |
| Data Sub-Carriers    | 360                                     | 272    | 720      | 560    |
| Subchannels          | 15                                      | 17     | 30       | 35     |
| Symbol Period, $T_s$ | 102.9 $\mu$ s                           |        |          |        |
| Frame Duration       | 5 ms                                    |        |          |        |
| OFDM Symbols/Frame   | 48 (including ~1.6 symbols for TTG/RTG) |        |          |        |
| Data OFDM Symbols    | 44                                      |        |          |        |

9

1 **Table 2-5 Mobile WiMAX PHY Data Rates with PUSC Subchannel<sup>3</sup>**

| Modulation | Code Rate   | 5 MHz Channel            |                        | 10 MHz Channel           |                        |
|------------|-------------|--------------------------|------------------------|--------------------------|------------------------|
|            |             | Downlink<br>Rate, Mbit/s | Uplink<br>Rate, Mbit/s | Downlink<br>Rate, Mbit/s | Uplink<br>Rate, Mbit/s |
| QPSK       | 1/2 CTC, 6x | 0.53                     | 0.38                   | 1.06                     | 0.78                   |
|            | 1/2 CTC, 4x | 0.79                     | 0.57                   | 1.58                     | 1.18                   |
|            | 1/2 CTC, 2x | 1.58                     | 1.14                   | 3.17                     | 2.35                   |
|            | 1/2 CTC, 1x | 3.17                     | 2.28                   | 6.34                     | 4.70                   |
|            | 3/4 CTC     | 4.75                     | 3.43                   | 9.50                     | 7.06                   |
| 16QAM      | 1/2 CTC     | 6.34                     | 4.57                   | 12.07                    | 9.41                   |
|            | 3/4 CTC     | 9.50                     | 6.85                   | 19.01                    | 14.11                  |
| 64QAM      | 1/2 CTC     | 9.50                     | 6.85                   | 19.01                    | 14.11                  |
|            | 2/3 CTC     | 12.67                    | 9.14                   | 26.34                    | 18.82                  |
|            | 3/4 CTC     | 14.26                    | 10.28                  | 28.51                    | 21.17                  |
|            | 5/6 CTC     | 15.84                    | 11.42                  | 31.68                    | 23.52                  |

2  
3 The BS scheduler determines the appropriate data rate (or burst profile) for each burst  
4 allocation based on the buffer size, channel propagation conditions at the receiver, etc. A CQI  
5 (Channel Quality Indicator) channel is utilized to provide channel-state information from the  
6 user terminals to the BS scheduler. Relevant channel-state information can be fed back by the  
7 CQICH including: Physical CINR (Carrier to Interference + Noise Ratio), Effective CINR,  
8 MIMO (Multiple Input Multiple Output) mode selection and frequency selective subchannel  
9 selection. Because the implementation is TDD, link adaptation can also take advantage of  
10 channel reciprocity to provide a more accurate measure of the channel condition (such as  
11 sounding).

12 HARQ is enabled using N channel “Stop and Wait” protocol, which provides fast response to  
13 packet errors and improves cell edge coverage. Chase Combining and, optionally, Incremental  
14 Redundancy are supported to further improve the reliability of the retransmission. A dedicated  
15 ACK channel is provided in the uplink for HARQ ACK/NACK signaling. Multi-channel HARQ

---

<sup>3</sup> PHY Data Rate=(Data sub-carriers/Symbol period)x(information bits per symbol).

1 operation is supported. Multi-channel stop-and-wait ARQ with a small number of channels is an  
2 efficient, simple protocol that minimizes the memory required for HARQ and stalling. Mobile  
3 WiMAX provides signaling to allow fully asynchronous operation. The asynchronous operation  
4 allows variable delay between retransmissions, which gives more flexibility to the scheduler at  
5 the cost of additional overhead for each retransmission allocation. HARQ combined together  
6 with CQICH and adaptive modulation and coding provides robust link adaptation in mobile  
7 environments at vehicular speeds in excess of 120 km/hr.

8 Multiple antenna technologies typically involve complex vector or matrix operations on  
9 signals due to the presence of multiple antenna links between the transmitter and receiver.  
10 OFDMA allows multiple antenna operations to be performed on a per-subcarrier basis, where  
11 the vector-channels are flat fading. This fact makes the multiple antenna signal processing  
12 manageable at both transmitter and receiver side since complex transmitter architectures and  
13 receiver equalizers are not required to compensate for frequency selective fading. Thus, OFDMA  
14 is very well-suited to support multiple antenna technologies. Mobile WiMAX supports a full  
15 range of multiple antenna technologies to enhance system performance. The supported multiple  
16 antenna technologies include:

- 17 • Beamforming (BF) for both the uplink and the downlink: With BF, the system uses  
18 multiple-antennas to both receive and transmit signals to improve the coverage and capacity  
19 of the system and reduce the outage probability. The BS is usually equipped with two or more  
20 antennas, with a typical number being four antennas, and determines so-called antenna  
21 weights for both uplink reception and downlink transmission, while the MS is usually  
22 equipped with one or two antennas for downlink reception and one antenna for uplink  
23 transmission. Note that different BF techniques can be applied in Mobile WiMAX since there  
24 is no limitation imposed either to the distance among the antenna elements of the BS or the  
25 algorithm employed at the BS transceiver; the possibility of beamforming the pilot  
26 subcarriers during downlink transmission (feature of dedicated pilots in the mobile WiMAX  
27 system profiles) makes the application of specific BF algorithms transparent to the MS  
28 receiver.
- 29 • Space-Time Coding (STC) for the downlink: Two-antenna transmit diversity is enabled in  
30 Mobile WiMAX through the use of a space-time block coding code widely known as the  
31 Alamouti code. STC is a powerful technique for implementing open-loop transmit diversity,  
32 while its performance is further increased in Mobile WiMAX since a second antenna is  
33 mandated to be present at the MS receiver. Further, STC offers favorable performance in all  
34 propagation environments, i.e., it is not constrained by the MIMO channel quality usually  
35 represented by the spread of the MIMO channel eigenvalues. As in the BF case where one

1 spatial stream is transmitted over one OFDMA symbol per subcarrier, STC cannot lead to  
2 link throughput increase because it transmits two spatial streams over two OFDMA symbols  
3 per subcarrier.

- 4 • Spatial Multiplexing (SM) for the downlink: Spatial multiplexing is supported to apply  
5 higher peak rates and increased throughput whenever this is possible. With spatial  
6 multiplexing, two data streams are transmitted over one OFDMA symbol per subcarrier.  
7 Since the MS receiver is also equipped with two receive antennas, it can separate the two  
8 data streams to achieve higher throughput compared to single antenna, BF, and STC  
9 systems. In Mobile WiMAX, with 2x2 MIMO SM increases the peak data rate two-fold by  
10 transmitting two data streams.
- 11 • Collaborative Spatial Multiplexing (CSM), also referred to as virtual spatial multiplexing, for  
12 the uplink: In the uplink, each MS is equipped with a single transmit antenna. To increase  
13 the uplink performance, two users can transmit collaboratively in the same frequency and  
14 time allocation as if two streams were spatially multiplexed from two antennas of the same  
15 user. The advantage of the uplink CSM compared to the downlink SM is related to the fact  
16 that the transmitted spatial streams are uncorrelated since they originate from spatially  
17 displaced MSs. By additionally considering that the channel correlation factor at the BS can  
18 be kept at lower values than that at the MS receiver (space limitations at the MS usually  
19 apply leading to smaller inter-antenna distances and, thus, higher correlation values,  
20 especially if cross-polarized antennas are not employed), an improved performance of the  
21 spatial stream demultiplexing is expected in the uplink compared to the downlink.

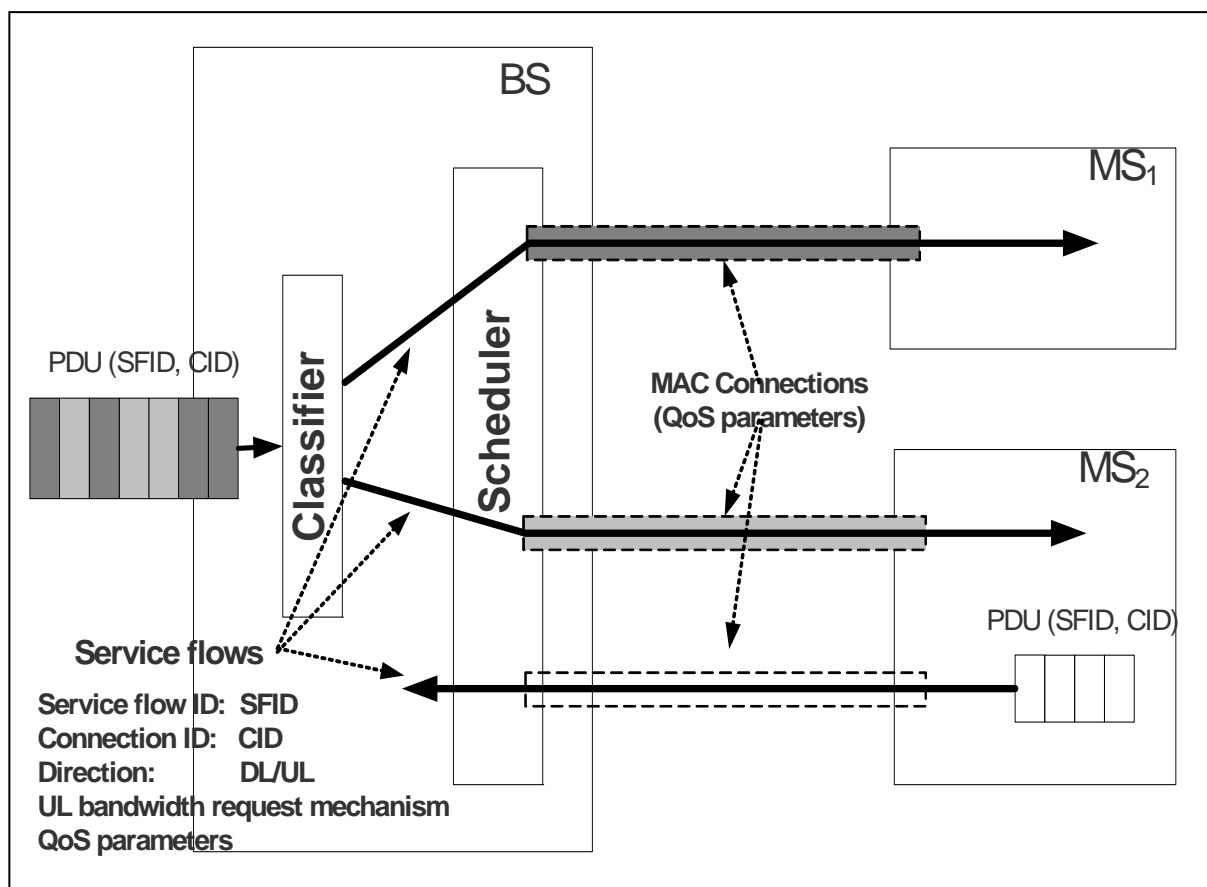
22  
23 Regarding the MIMO operation in the downlink (use of the STC and SM modes), Mobile  
24 WiMAX supports adaptive switching between STC and SM to maximize the benefit of MIMO  
25 depending on the channel conditions. For instance, SM improves peak throughput. However,  
26 when channel conditions are poor, e.g., when the signal-to-interference ratio is low or the  
27 channel correlation factor is relatively high, the PER (packet error rate) can be high and thus  
28 the coverage area where the target PER is met may be limited. STC on the other hand provides  
29 large coverage regardless of the channel condition but does not improve the peak data rate.  
30 Mobile WiMAX supports adaptive switching between multiple MIMO modes to maximize  
31 spectral efficiency without compromising on the coverage area.

## 32 33 2.4 MAC Layer Description

34 Mobile WiMAX supports the delivery of broadband services, including voice, data, and video.  
35 The MAC layer can support bursty data traffic with high peak rate demand while

1 simultaneously supporting streaming video and latency-sensitive voice traffic over the same  
 2 channel. The resource allocated to one terminal by the MAC scheduler can vary from a single  
 3 time slot to the entire frame, thus providing a very large dynamic range of throughput to a  
 4 specific user terminal at any given time. Furthermore, since the resource allocation information  
 5 is conveyed in the MAP messages at the beginning of each frame, the scheduler can effectively  
 6 change the resource allocation on a frame-by-frame basis to adapt to the bursty nature of the  
 7 traffic.

8



9

10 **Figure 2-11 Mobile WiMAX QoS Support**

11

#### 12 2.4.1 Quality of Service (QoS) Support

13 With fast air link, symmetric downlink/uplink capacity, fine resource granularity and a  
 14 flexible resource allocation mechanism, Mobile WiMAX can meet QoS requirements for a wide  
 15 range of data services and applications.

16 In the Mobile WiMAX MAC layer, QoS is provided via service flows as illustrated in Figure  
 17 2-11. A service flow is a unidirectional flow of packets provided with a particular set of QoS

1 parameters. Before providing a certain type of data service, the BS and MS first establish a  
 2 unidirectional logical link between the peer MACs, called a connection. The outbound MAC then  
 3 associates packets traversing the MAC interface into a service flow to be delivered over the  
 4 connection. The QoS parameters associated with the service flow define the transmission  
 5 ordering and scheduling on the air interface. The connection-oriented MAC can therefore  
 6 provide accurate QoS control over the air interface. Since the air interface is usually the  
 7 bottleneck, the connection-oriented MAC can effectively enable end-to-end QoS control. The  
 8 service flow parameters can be dynamically managed through MAC messages to accommodate  
 9 the dynamic service demand. The service flow based QoS mechanism applies to both DL and UL  
 10 to provide improved QoS in both directions. Mobile WiMAX supports a wide range of data  
 11 services and applications with varied QoS requirements. These are summarized in Table 2-6.  
 12

13 **Table 2-6 Mobile WiMAX Applications and Quality of Service**

| QoS Category                             | Applications                         | QoS Specifications   |
|--|--------------------------------------|--|
| UGS: Unsolicited Grant Service           | VoIP                                 | Maximum Sustained Rate<br>Maximum Latency Tolerance<br>Jitter Tolerance  |
| rtPS: Real-Time Packet Service           | Streaming Audio or Video             | Minimum Reserved Rate<br>Maximum Sustained Rate<br>Maximum Latency Tolerance<br>Traffic Priority                     |
| ErtPS: Extended Real-Time Packet Service | Voice with Activity Detection (VoIP) | Minimum Reserved Rate<br>Maximum Sustained Rate<br>Maximum Latency Tolerance<br>Jitter Tolerance<br>Traffic Priority |
| nrtPS: Non-Real-Time Packet Service      | File Transfer Protocol (FTP)         | Minimum Reserved Rate<br>Maximum Sustained Rate<br>Traffic Priority  |
| BE: Best-Effort Service                  | Data Transfer, Web Browsing, etc.    | Maximum Sustained Rate<br>Traffic Priority   |

14  
 15 **2.4.2 MAC Scheduling Service**

16 The Mobile WiMAX MAC scheduling service is designed to efficiently deliver time-sensitive  
 17 broadband data services including voice, data, and video over time-varying broadband wireless  
 18 channel. The MAC scheduling service has the following properties that enable this real-time  
 19 broadband data service:

- 1 • Fast Data Scheduler: The MAC scheduler must efficiently allocate available resources in  
2 response to bursty data traffic and time-varying channel conditions. The scheduler is  
3 located at each BS to enable rapid response to traffic requirements and channel conditions.  
4 The data packets are associated to service flows with well defined QoS parameters in the  
5 MAC layer so that the scheduler can correctly determine the packet transmission ordering  
6 over the air interface. The CQICH channel provides fast channel information feedback to  
7 enable the scheduler to choose the appropriate coding and modulation for each allocation.  
8 The adaptive modulation/coding combined with HARQ provide robust transmission over the  
9 time-varying channel.
- 10 • Scheduling for both DL and UL: The scheduling service is provided for both DL and UL  
11 traffic. In order for the MAC scheduler to make an efficient resource allocation and provide  
12 the desired QoS in the UL, the UL must feedback accurate and timely information as to the  
13 traffic conditions and QoS requirements. Multiple uplink bandwidth request mechanisms  
14 (such as bandwidth request through ranging channel, piggyback request, and polling) are  
15 specified. The UL service flow defines the feedback mechanism for each uplink connection to  
16 ensure predictable UL scheduler behavior. Furthermore, with orthogonal UL subchannels,  
17 there is no intra-cell interference. UL scheduling can allocate resource more efficiently and  
18 better enforce QoS.
- 19 • Dynamic Resource Allocation: The MAC supports frequency-time resource allocation in both  
20 DL and UL on a per-frame basis. The resource allocation is delivered in MAP messages at  
21 the beginning of each frame. Therefore, the resource allocation can be changed on  
22 frame-by-frame in response to traffic and channel conditions. Additionally, the amount of  
23 resource in each allocation can range from one slot to the entire frame. The fast and fine  
24 granular resource allocation allows superior QoS for data traffic.
- 25 • UL and DL QoS: The MAC scheduler handles data transport on a connection-by-connection  
26 basis. Each connection is associated with a single data service with a set of QoS parameters  
27 that quantify the aspects of its behavior. With the ability to dynamically allocate resources  
28 in both DL and UL, the scheduler can provide QoS for both DL and UL traffic.
- 29 • Frequency Selective Scheduling: The scheduler can operate on different types of  
30 subchannels. For frequency-diverse subchannels such as PUSC permutation, where  
31 sub-carriers in the subchannels are pseudo-randomly distributed across the bandwidth,  
32 subchannels are of similar quality. Frequency-diversity scheduling can support a QoS with  
33 fine granularity and flexible time-frequency resource scheduling. With contiguous  
34 permutation such as AMC permutation, the subchannels may experience different  
35 attenuation. The frequency-selective scheduling can allocate mobile users to their

1 corresponding strongest subchannel. The frequency-selective scheduling can enhance  
2 system capacity with a moderate increase in CQI overhead in the UL.

- 3 • Admission Control: Admission Control admits service flows based on resource availability.  
4 That is, a service flow is either admitted or rejected during service flow creation transaction.  
5 Admission Control is implemented on the various network elements: Server, BS and MS.
- 6 • Policing: A service flow is prohibited from injecting data traffic that exceeds its Maximum  
7 Sustained Traffic Rate. Policing enforces this restriction.

### 8 9 2.4.3 Power control and boosting

10 Mobile WiMAX defines two modes of power control.

- 11 • Closed Loop Power Control, in which the BSs regularly adjusts the transmission level of  
12 each terminals based on the measurements done on received data from this terminal.
- 13 • Open Loop Power Control, in which the terminal adjusts its transmission level based on the  
14 signal strength measured on the received preamble from the serving BS. The serving BS is  
15 furthermore allowed to correct this transmission level, based on received signal strength.  
16 This correction is normally performed at very low frequency rate, enough to meet the  
17 requirement of the BS.

18  
19 Furthermore, power boosting on data is a mechanism that can be used by the BS in order to  
20 extend its coverage. It is particularly convenient in an OFDMA scheme, where some  
21 subchannels can be boosted and some others attenuated, on the same OFDM symbol(s). The BS  
22 is hence able to use such boosting for further increasing the granularity of its link adaptation  
23 and the network load balancing.

### 24 25 2.4.4 Mobility Management

26 Battery life and handover are two critical issues for mobile applications. Mobile WiMAX  
27 supports Sleep Mode and Idle Mode to enable power-efficient MS operation. Mobile WiMAX also  
28 supports seamless handover to enable the MS to switch from one BS to another at vehicular  
29 speeds without interrupting the connection.

### 30 31 2.4.5 Power Management

32 Mobile WiMAX supports two modes for power efficient operation – Sleep Mode and Idle Mode.  
33 Sleep Mode is a state in which the MS conducts pre-negotiated periods of absence from the  
34 Serving BS air interface. These periods are characterized by the unavailability of the MS, as

1 observed from the Serving BS, to DL or UL traffic. Sleep Mode is intended to minimize MS  
2 power usage and minimize the usage of the Serving BS air interface resources. The Sleep Mode  
3 also provides flexibility for the MS to scan other BSs to collect information to assist handover  
4 during the Sleep Mode.

5 Idle Mode provides a mechanism for the MS to become periodically available for DL broadcast  
6 traffic messaging without registration at a specific BS as the MS traverses an air link  
7 environment populated by multiple BSs. Idle Mode benefits the MS by removing the  
8 requirement for handover and other normal operations and benefits the network and BS by  
9 eliminating air interface and network handover traffic from essentially inactive MSs while still  
10 providing a simple and timely method (paging) for alerting the MS about pending DL traffic.

#### 11 12 2.4.6 Handover

13 There are three handover methods supported within the IEEE 802.16 standard – Hard  
14 Handover, Fast BS Switching, and Macro Diversity Handover. Of these, the HHO is mandatory.

15 WiMAX Forum Mobile System Profile specifies a set of techniques for optimizing handover  
16 within the framework of the IEEE 802.16. These improvements have been developed with the  
17 goal of keeping Layer 2 handover delays to less than 50 milliseconds.

18 When FBSS (Fast Base Station Switching) is supported, the MS and BS maintain a list of BSs  
19 that are involved in FBSS with the MS. This set is called an Active Set. In FBSS, the MS  
20 continuously monitors the BSs in the Active Set. Among the BSs in the Active Set, an Anchor BS  
21 is defined. When operating in FBSS, the MS communicates only with the Anchor BS for uplink  
22 and downlink messages, including management and traffic connections. Transition from one  
23 Anchor BS to another (i.e. BS switching) is performed without invocation of explicit HO  
24 signaling messages. Anchor update procedures are enabled by communicating signal strength of  
25 the serving BS via the CQICH. A FBSS handover begins with a decision by an MS to receive or  
26 transmit data from the Anchor BS that may change within the active set. The MS scans the  
27 neighbor BSs and selects those that are suitable to be included in the active set. The MS reports  
28 the selected BSs and the active set update procedure is performed by the BS and MS. The MS  
29 continuously monitors the signal strength of the BSs that are in the active set and selects one  
30 BS from the set to be the Anchor BS. The MS reports the selected Anchor BS on CQICH or MS  
31 initiated HO request message. An important requirement of FBSS is that the data is  
32 simultaneously transmitted to all members of an active set of BSs that are able to serve the MS.

#### 33 34 2.4.7 Security

35 Mobile WiMAX supports mutual device/user authentication, flexible key management

1 protocol, strong traffic encryption, control and management plane message protection, and  
2 security protocol optimizations for fast handovers.

3 The usage aspects of the security features are:

- 4 • Key Management Protocol: Privacy and Key Management Protocol Version 2 is the basis of  
5 Mobile WiMAX security as defined in the IEEE 802.16. This protocol manages the MAC  
6 security using PKM (Public Key Management)-REQ/RSP (Request/Response) messages.  
7 PKM EAP (Extensible Authentication Protocol) authentication, Traffic Encryption Control,  
8 Handover Key Exchange, and Multicast/Broadcast security messages all are based on this  
9 protocol.
- 10 • Device/User Authentication: Mobile WiMAX supports Device and User Authentication  
11 using the IETF EAP protocol, providing support for credentials that are based on a SIM,  
12 USIM, Digital Certificate, or User Name/Password. Corresponding EAP-SIM, EAP-AKA  
13 (Extensible Authentication Protocol-Authentication and Key Agreement), EAP-TLS  
14 (Extensible Authentication Protocol-Transport Layer Security), or EAP-MSCHAPv2  
15 (Extensible Authentication Protocol-Microsoft Challenge Handshake Authentication  
16 Protocol Version 2) authentication methods are supported through the EAP protocol. Key  
17 deriving methods are the only EAP methods supported.
- 18 • Traffic Encryption: AES-CCM (Advanced Encryption Standard-Counter with Cipher-block  
19 chaining Message authentication code) is the cipher used for protecting all the user data  
20 over the Mobile WiMAX MAC interface. The keys used for driving the cipher are generated  
21 from the EAP authentication. A Traffic Encryption state machine with a periodic key  
22 refresh mechanism enables sustained transition of keys to further improve protection.
- 23 • Control Message Protection: Control data is protected using AES based CMAC (block  
24 Cipher-based Message Authentication Code) or MD5-based HMAC schemes.
- 25 • Fast Handover Support: A 3-way handshake scheme is supported by Mobile WiMAX to  
26 optimize the re-authentication mechanisms for supporting fast handovers. This mechanism  
27 is also useful to prevent man-in-the-middle-attacks.

28

## 29 2.5 Enhancements in the WiMAX Forum System Profile Release 1.5

- 30 • FDD mode of operation: The WiMAX deployment in paired spectrum by extending the TDD  
31 based system profile is enabled.
- 32 • Advanced services: Location based service and improved multicast/broadcast services are  
33 added.
- 34 • MAC layer efficiency: MAP overhead is lowered especially for VoIP traffic and reduction of  
35 latencies

- Closed-loop MIMO: Closed-loop MIMO is included to improve coverage and capacity.

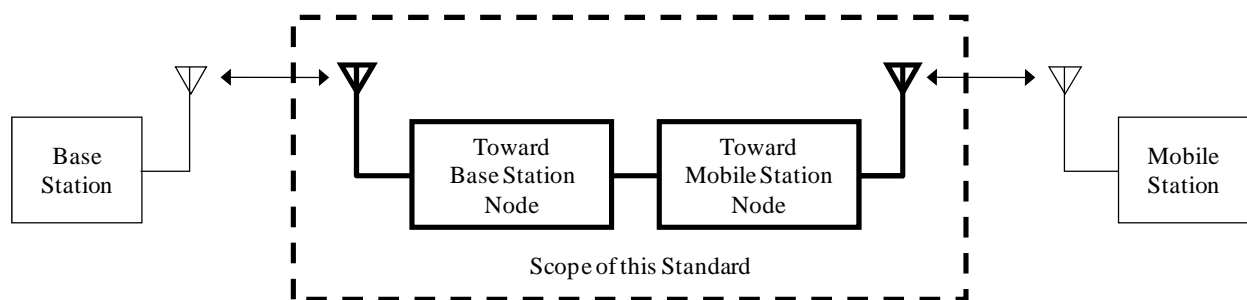
## 2.6 Low Power Repeater

### 2.6.1 Outline

The Low Power Repeaters for Mobile WiMAX are operated in the frequency band of 2.5GHz which are assigned for BWA system in Regenerative and Non-regenerative relay manner. The requirements are compliant to the paragraphs 3.3, Regulation Article 49.28 of the ORE and other related Regulation Articles.

### 2.6.2 Configuration

The Mobile WiMAX repeater consists of Toward Base Station Node and Toward Mobile Station Node and antennas in both uplink and downlink directions. The scope of this standard is shown in Figure 2-12. This standard specifies the minimum radio-frequency performance requirements of the Mobile WiMAX repeater to be deployed under the blanket license in Japan.



**Figure 2-12 Repeater Configuration**

## Chapter 3 Technical Requirements for WiMAX Systems

For the mobile communications system of a WiMAX system using the 2.5 GHz band, the following prerequisites shall be satisfied.

This chapter is translated into English from the original regulations contained in MIC Ordinances and related Notifications. The original in Japanese shall prevail if any ambiguity exists between the following requirements and the original in Japanese.

### 3.1 Overview

It is assumed that the types of radio equipment are as follows:

- <1> Mobile station
- <2> Base station
- <3> Repeater station (radio station that relays a signal when direct broadband mobile radio communications between a BS and a MS is not possible. The technical prerequisites for MSs shall apply to the upstream links, while those for the BS shall apply to the downstream links.)

### 3.2 General condition

#### (1) Communications system

Time Division Duplex (TDD) system

#### (2) Frequency (ORE, Article 49.28)

2545MHz – 2625MHz

#### (3) Multiplexing system

##### a Mobile station (upstream link)

Orthogonal Frequency Division Multiple Access (OFDMA) system

##### b Base station (downstream link)

Composite system using an Orthogonal Frequency Division Multiplexing (OFDM) system and a Time Division Multiplexing (TDM) system

#### (4) Modulation system (ORE, Article 49.28)

##### a Mobile station (upstream link)

QPSK, 16QAM or 64QAM

1        b Base station (downstream link)

2                BPSK, QPSK, 16QAM, or 64QAM

3  
4        (5) Transmission synchronization

5                a Transmission burst repetition period

6                        5 ms

7                b The transmission burst lengths for Base stations and Mobile stations in Table 3-1 (NT  
8                        No.651,2007)

9  
10                        **Table 3-1 Maximum Permissible Transmission Burst Length**

| Maximum permissible transmission burst length [ms] |                |
|--|----------------|
| Base station                                       | Mobile station |
| 3.65   | 1.35           |
| 3.55   | 1.45           |
| 3.45   | 1.55           |
| 3.35   | 1.65           |
| 3.25   | 1.75           |
| 3.15   | 1.85           |
| 3.05   | 1.95           |
| 2.95   | 2.05           |
| 2.85   | 2.15           |
| 2.75   | 2.25           |

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24  
25                        Transmission Burst Lengths Tolerance

26                        Base Station:    +10 $\mu$ s or less, -90 $\mu$ s or over

27                        Mobile Station: +10 $\mu$ s or less, -130 $\mu$ s or over

28  
29        (6) Authentication, secrecy, and information security

30                The assignment of numbers specific to mobile station equipment so as to prevent  
31                unauthorized use, the application of authentication procedures, the use of secrecy  
32                functions for communications information, and other appropriate measures shall be  
33                implemented.

1 (7) Electromagnetic measures

2 Sufficient consideration shall be given to the mutual electromagnetic interference  
3 between Mobile stations and automotive electronic devices and medical electronic  
4 devices.

5  
6 (8) Conformance to the radio radiation protection guidelines

7 Mobile stations, as well as devices using radio waves shall conform to Regulations for  
8 Enforcement of the Radio Law, Article 21.3 and Ordinance Regulating Radio Equipment,  
9 Article 14.2.

10  
11 (9) Mobile station identification numbers

12 It is preferable for the procedures for assigning and subsequently sending identification  
13 numbers to Mobile stations be established with sufficient consideration given to the  
14 selection of networks by users, roaming, the assurance of communications security, the  
15 supervision of radio stations, and so on.

16  
17 (10) Stopping emission of radio waves in the event of a fault in a Mobile station's  
18 transmission equipment

19 The functions below shall be executed at the same time, but independently of each  
20 other.

21 a Function whereby, if a Base station detects an error in a Mobile station, the Base  
22 station issues a request to that Mobile station to stop transmission.

23 b Function whereby, if a Mobile station itself detects an internal error, the Mobile  
24 station stops transmission upon the timeout of the error detection timer.

25  
26 (11) Structure of transmitter

27 The main part of the transmit device (RF and Modem devices, except Antenna device)  
28 shall not be opened easily.

29  
30 (12) Functions to ensure Model-1 Mobile station to be used only indoor coverage

31 As a general rule, input power source for Model-1 Mobile station shall be AC (alternate  
32 current). However, for Mobile station that require DC power source shall not start its  
33 operation before it receives operation starting signal from the parent device. ( PC etc.)

34

1 (13) Definitions of the Models for Fixed Wireless Access system with antenna gain for  
2 Mobile station more than 2dBi.

3  
4 In case of the Mobile station communicating with the Base station whose antenna gain is  
5 17dBi or less;

6  
7 - Model-1 Mobile station: Radio equipment with more than 2dBi and 10dBi or less  
8 antenna gain.

9 - Model-2 Mobile station: Radio equipment with more than 10dBi antenna gain.

10  
11 In case of the Mobile station communicating with the Base station whose antenna gain is  
12 more than 17dBi.

13  
14 Model-3 Mobile station: Radio equipment with more than 17dBi and 25dBi or less  
15 antenna gain.

16  
17 (14) Restrictions on FWA system deployment (NT No.651, 2007)

18  
19 a Restrictions for Base stations

20  
21 Note 1: Following Base stations shall be limited for use in depopulated areas, mountain  
22 villages, isolated island areas or the areas authorized by Minister of Internal Affairs  
23 and Communications.

24  
25 - The Base station that communicates with the Mobile station with 2dBi or greater  
26 antenna gain or repeater station.

27 - The Base station whose antenna gain is greater than 17dBi.

28  
29 Note 2: The Base station whose antenna gain is greater than 17dBi shall only  
30 communicate with only a single radio station.

31  
32 b Restrictions for Mobile stations

33  
34 In case of Mobile station that communicates with the Base station with the antenna gain  
35 of 17dBi or less.

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Note 1: Mobile station with the antenna gain of greater than 2dBi but not exceeding 10dBi shall be limited for use in a closed environment or equivalent place.

Note 2: Mobile station whose antenna gain is more than 2dBi shall be limited for use in depopulated areas, mountain villages, isolated islands or the areas authorized by Minister of Internal Affairs and Communications.

Note 3: Mobile station whose antenna gain is greater than 2dBi shall not start its operation under any Base station that is installed in places other than those specified in Note 2. At least one of the functions below should be implemented for this purpose.

- Function to enable the Mobile station with high gain antenna to determine, by using WiMAX broadcast message, whether the area is authorized or not.
- Function to enable terminal authentication on the network side to deny the network entry by the high gain antenna Mobile stations within the unauthorized area, if it is agreed upon between WiMAX operators.
- Other functions which have been agreed upon between the WiMAX operators.

In case of Mobile station that communicates with the Base station whose antenna gain is greater than 17dBi

Note 1: Mobile station shall be limited for use in depopulated areas, mountain villages, isolated islands or the areas authorized by Minister of Internal Affairs and Communications.

Note 2: Mobile station shall not start operation under any Base station that is installed in places other than those specified in Note 1. At least one of the functions below should be implemented for this purpose.

- Function to enable the Mobile station to determine, by using WiMAX broadcast message, whether the area is authorized or not.

1           -   Function to enable terminal authentication on the network side to deny the  
2           network entry by the Mobile stations within the unauthorized area, if it is agreed  
3           upon between WiMAX operators.

4  
5           -   Other functions which have been agreed upon between the WiMAX operators.

6

### 7   3.2.1   Transmitter requirement for Mobile WiMAX equipment

#### 8   3.2.1.1   Frequency tolerance (ORE, Article 5, Table 1)

9           Mobile station:                 Within  $2 \times 10^{-6}$

10          Base station:                 Within  $2 \times 10^{-6}$

11

#### 12   3.2.1.2   Occupied band width (ORE, Article 6, Table 2)

13          5 MHz system:                 4.9 MHz or less

14          10 MHz system:                9.9 MHz or less

15

#### 16   3.2.1.3   Output power (ORE, Article 49.28)

17          Mobile station:                400 mW or less

18          Base station:                 20 W or less

19

#### 20   3.2.1.4   Output power tolerance (ORE, Article 14)

21          Mobile station:                 $\pm 50\%$

22          Base station:                  $\pm 50\%$

23

#### 24   3.2.1.5   Adjacent channel leakage power (NT No.651,2007)

25          (1) Mobile station

26           (i) 5MHz system

27           Channel space:                 5MHz

28           Occupied bandwidth:           4.8MHz

29           Permissible adjacent channel leakage power:   5dBm or less

30           (ii) 10MHz system

31           Channel space:                 10MHz

32           Occupied bandwidth :           9.5MHz

33           Permissible adjacent channel leakage power:   3dBm or less

34

- 1 (2) Base station  
 2 (i) 5MHz system  
 3 Channel space: 5MHz  
 4 Occupied bandwidth: 4.8MHz  
 5 Permissible adjacent channel leakage power: 7dBm or less  
 6 (ii) 10MHz system  
 7 Channel space: 10MHz  
 8 Occupied bandwidth: 9.5MHz  
 9 Permissible adjacent channel leakage power: 3dBm or less

10

11 3.2.1.6 Spectrum mask (NT No.651, 2007)

- 12 (1) Mobile station  
 13 (i) 5MHz system  
 14 offset frequency:  $\Delta f$  Permissible level  
 15 7.5MHz or more and less than 8MHz, less than  $-20-2.28x(\Delta f-7.5)$  dBm/MHz  
 16 8MHz or more and less than 17.5MHz, less than  $-21-1.68x(\Delta f-8)$  dBm/MHz  
 17 17.5MHz or more and less than 22.5MHz, less than  $-37$ dBm/MHz  
 18  
 19 (ii) 10MHz system  
 20 offset frequency:  $\Delta f$  Permissible level  
 21 15MHz or more and less than 20MHz, less than  $-21-32/19x(\Delta f-10.5)$  dBm/MHz  
 22 20MHz or more and less than 25MHz, less than  $-37$ dBm/MHz  
 23  
 24 (2) Base station  
 25 (i) 5MHz system  
 26 offset frequency:  $\Delta f$  Permissible level  
 27 7.5MHz or more and less than 12.25MHz, less than  $-15-1.4x(\Delta f-7.5)$  dBm/MHz  
 28 12.25MHz or more and less than 22.5MHz, less than  $-22$ dBm/MHz  
 29  
 30 (ii) 10MHz system  
 31 offset frequency:  $\Delta f$  Permissible level  
 32 15MHz or more and less than 25MHz, less than  $-22$ dBm/MHz  
 33

## 1 3.2.1.7 Spurious emission (NT No.651,2007)

## 2 (1) Mobile station

| 3  | Frequency band                           | Permissible Level                         |
|----|--|---|
| 4  | 9kHz or more and less than 150kHz,       | less than -13dBm/kHz                      |
| 5  | 150kHz or more and less than 30MHz,      | less than -13dBm/10kHz                    |
| 6  | 30MHz or more and less than 1000MHz,     | less than -13dBm/100kHz                   |
| 7  | 1000MHz or more and less than 2505MHz,   | less than -13dBm/MHz                      |
| 8  | 2505MHz or more and less than 2530MHz,   | less than -37dBm/MHz                      |
| 9  | 2530MHz or more and less than 2535MHz,   | less than $1.7f-4338$ dBm/MHz             |
| 10 | 2535MHz or more and less than 2630MHz,   | less than -18dBm/MHz                      |
| 11 | 2630MHz or more and less than 2630.5MHz, | less than $-13-8/3.5x(f-2627)$ dBm/MHz    |
| 12 | 2630.5MHz or more and less than 2640MHz, | less than $-21-16/9.5x(f-2630.5)$ dBm/MHz |
| 13 | 2640MHz or more and less than 2655MHz,   | less than -37dBm/MHz                      |
| 14 | 2655MHz or more,                         | less than -13dBm/MHz                      |

15

16 Permissible level for 2535MHz or more and less than 2630MHz should be applied to the  
 17 frequency range where a frequency offset from the center frequency of a carrier is equal to  
 18 or more than 2.5 times of the system frequency bandwidth.

19

## 20 (2) Base station

| 21 | Frequency band                            | Permissible Level                       |
|----|---|---|
| 22 | 9kHz or more and less than 150kHz,        | less than -13dBm/kHz                    |
| 23 | 150kHz or more and less than 30MHz,       | less than -13dBm/10kHz                  |
| 24 | 30MHz or more and less than 1000MHz,      | less than -13dBm/100kHz                 |
| 25 | 1000MHz or more and less than 2505MHz,    | less than -13dBm/MHz                    |
| 26 | 2505MHz or more and less than 2535MHz,    | less than -42dBm/MHz                    |
| 27 | 2535MHz or more and less than 2630MHz,    | less than -13dBm/MHz                    |
| 28 | 2630MHz or more and less than 2634.75MHz, | less than $-15-7/5x(f-2629.75)$ dBm/MHz |
| 29 | 2634.75MHz or more and less than 2655MHz, | less than -22dBm/MHz                    |
| 30 | 2655MHz or more,                          | less than -13dBm/MHz                    |

31

32 Permissible level for 2535MHz or more and less than 2630MHz should be applied to the  
 33 frequency range where a frequency offset from the center frequency of a carrier is equal to  
 34 or more than 2.5 times of the system frequency bandwidth.

35

1 3.2.1.8 Intermodulation (NT No.651, 2007)

2 (1) 5 MHz System

3 Intermodulation emission generated by mixing a desirable emission within regulated power  
4 and disturbing waves at  $\pm 5$  MHz offset and at  $\pm 10$  MHz offset from the desired emission  
5 with powers of 30dB less than that of desirable emission should be less than permissible  
6 level of the spurious emission and adjacent channel leakage power.

7

8 (2) 10 MHz system

9 Intermodulation emission generated by mixing a desirable emission within regulated power  
10 and disturbing waves at  $\pm 10$  MHz offset and at  $\pm 20$  MHz offset from the desired emission  
11 with powers of 30dB less than that of desirable emission should be less than permissible  
12 level of the spurious emission and adjacent channel leakage power.

13

14 3.2.1.9 Standby output power (ORE, Article 49.28)

15 Mobile station: -30dBm or less

16 Base station: -30dBm or less

17

18 3.2.1.10 Antenna gain (ORE, Article 49.28)

19 Mobile station: 5dBi or less\*

20 Base station: 17dBi or less

21 \*If an antenna gain of mobile station is over 2dBi, EIRP shall be 28dBm or less.

22

23 3.2.1.11 Cabinet radiation

24 Cabinet radiation in EIRP shall be 4nW/MHz or less or the value obtained by adding 0dBi  
25 to the permissible spurious emission\* in the spurious region measured at the antenna  
26 input terminal.

27 (\* Refer to subclause 3.2.1.7 for the spurious emission.)

28

29 3.2.2 Receiver requirement for Mobile WiMAX equipment

30 3.2.2.1 Reception sensitivity

31 (1) Definition

32 The reception sensitivity shall be defined by the minimum receiver input level (dBm)  
33 which yields a bit error rate (BER) of  $1 \times 10^{-6}$  for the QPSK case under AWGN channel.

34 This is the definition for the specified reception sensitivity as well.

35

1 (2) Specification

2 5MHz bandwidth system

3 Mobile station: -91.3dBm or less

4 Base station: -91.3dBm or less

5  
6 10MHz bandwidth system

7 Mobile station: -88.3dBm or less

8 Base station: -88.3dBm or less

9  
10 3.2.2.2 Spurious response rejection ratio

11 (1) Definition

12 The spurious response rejection ratio shall be defined as the level ratio of the interfering  
13 signal to the desired signal, specified by the following statement:

14 The level of desired signal shall be set to +3 dB higher than the level of the specified  
15 reception sensitivity\*. The level of interfering signal shall be the one yielding a bit error  
16 rate of  $1 \times 10^{-6}$  on the desired signal for the QPSK case. The interfering signal shall not  
17 be modulated.

18 (\* Refer to subclause 3.2.2.1 for the specified reception sensitivity.)

19  
20 (2) Specification

21 Mobile station: The spurious response rejection ratio shall be 11dB or more.

22 Base station: The spurious response rejection ratio shall be 11dB or more.

23  
24 3.2.2.3 Adjacent signal selectivity

25 (1) Definition

26 The adjacent signal selectivity shall be defined as the level ratio of the interfering signal  
27 to the desired signal, specified by the following statement:

28 The level of desired signal shall be set to +3 dB higher than the level of the specified  
29 reception sensitivity\*. The level of interfering signal shall be the one yielding a bit error  
30 rate of  $1 \times 10^{-6}$  on the desired signal for 16QAM. The interfering signal shall be 16QAM  
31 and tuned on the first adjacent channel.

32 (\* Refer to Section 3.2.2.1 for the specified reception sensitivity)

33  
34 (2) Specification

35 Mobile stations: The adjacent signal selectivity shall be 11dB or more.

1           Base station:       The adjacent signal selectivity shall be 11dB or more.

2

3   3.2.2.4 Intermodulation performance

4       (1) Definition

5           The intermodulation performance shall be defined as the level of the interfering signal,  
6           specified by the following statement:

7           The level of desired signal shall be set to +3 dB higher than the level of the specified  
8           reception sensitivity\*. The level of each one of two interfering signals shall be the one  
9           yielding a bit error rate of  $1 \times 10^{-6}$  on the desired signal. The interfering signals shall be  
10          tuned on the first and second adjacent channel.

11          (\* Refer to Section 3.2.2.1 for the specified reception sensitivity)

12

13       (2) Specification

14          Mobile stations:

15           The non-modulated interfering signal on the first adjacent channel shall be -55dBm.

16           The modulated interfering signal on the second adjacent channel shall be -55dBm.

17

18          Base station:

19           The non-modulated interfering signal on the first adjacent channel shall be -45dBm.

20           The modulated interfering signal on the second adjacent channel shall be -45dBm.

21

22   3.2.2.5 Conducted Spurious (ORE, Article 24)

23

24           Less than 1GHz:       4nW or less

25           1GHz or more:       20nW or less

26

27   3.2.3 Transmitter requirement for FWA equipment

28   3.2.3.1 Frequency tolerance (ORE, Article 5, Table 1)

29           Land mobile station:    Within  $2 \times 10^{-6}$

30           Base station:            Within  $2 \times 10^{-6}$

31

32   3.2.3.2 Occupied band width (ORE, Article 6, Table 2)

33           5 MHz system:           4.9 MHz or less

34           10 MHz system:          9.9 MHz or less

35

## 1 3.2.3.3 Output power (ORE, Article 49.28)

2

3 Land mobile station

4 Model-1: 200mW or less

5

6 Model-2:

7 Antenna gain

8 20dBi or less: 200mW or less

9 More than 20dBi and 23dBi or less: 100mW or less

10 More than 23dBi and 25dBi or less: 63mW or less

11

12 Model-3 :

13 Antenna gain

14 23dBi or less: 200mW or less

15 More than 23dBi and 25dBi or less: 126mW or less

16

17

18 Base station

19 Antenna gain

20 17dBi or less: 20W or less

21

22 However that only for Model-3, output power is specified as follows.

23

24 More than 17dBi and 20dBi or less: 10W or less

25 More than 20dBi and 23dBi or less: 5W or less

26 More than 23dBi and 25dBi or less: 3.2W or less

27

## 28 3.2.3.4 Output power tolerance (ORE, Article 14)

29 Land mobile station: ±50%

30 Base station: ±50%

31

## 32 3.2.3.5 Adjacent channel leakage power (NT No.651, 2007)

33 (1) Mobile station

34 (i) 5MHz system

35 Channel space: 5MHz

|   |   |              |
|---|---|--------------|
| 1 | Occupied bandwidth:                         | 4.8MHz       |
| 2 | Permissible adjacent channel leakage power: | 2dBm or less |
| 3 | (ii) 10MHz system                           |              |
| 4 | Channel space:                              | 10MHz        |
| 5 | Occupied bandwidth:                         | 9.5MHz       |
| 6 | Permissible adjacent channel leakage power: | 0dBm or less |

|    |   |              |
|----|---|--------------|
| 7  |   |              |
| 8  | (2) Base station                            |              |
| 9  | (i) 5MHz system                             |              |
| 10 | Channel space:                              | 5MHz         |
| 11 | Occupied bandwidth:                         | 4.8MHz       |
| 12 | Permissible adjacent channel leakage power: | 7dBm or less |
| 13 | (ii) 10MHz system                           |              |
| 14 | Channel space:                              | 10MHz        |
| 15 | Occupied bandwidth:                         | 9.5MHz       |
| 16 | Permissible adjacent channel leakage power: | 3dBm or less |

3.2.3.6 Spectrum mask (NT No.651,2007)

(1) Mobile station

(i) 5MHz system

| 21 | <u>offset frequency : <math>\Delta f</math></u> | <u>Permissible level</u>                    |
|----|---|---|
| 22 | 7.5MHz or more and less than 8MHz,              | less than $-20-2.28x(\Delta f-7.5)$ dBm/MHz |
| 23 | 8MHz or more and less than 17.5MHz,             | less than $-21-1.68x(\Delta f-8)$ dBm/MHz   |
| 24 | 17.5MHz or more and less than 22.5MHz,          | less than $-37$ dBm/MHz                     |

(ii) 10MHz system

| 27 | <u>offset frequency : <math>\Delta f</math></u> | <u>Permissible level</u>                      |
|----|---|---|
| 28 | 15MHz or more and less than 20MHz,              | less than $-21-32/19x(\Delta f-10.5)$ dBm/MHz |
| 29 | 20MHz or more and less than 25MHz,              | less than $-37$ dBm/MHz                       |

(2) Base station

(i) 5MHz system

| 33 | <u>offset frequency : <math>\Delta f</math></u> | <u>Permissible level</u>                   |
|----|---|--|
| 34 | 7.5MHz or more and less than 12.25MHz,          | less than $-15-1.4x(\Delta f-7.5)$ dBm/MHz |
| 35 | 12.25MHz or more and less than 22.5MHz,         | less than $-22$ dBm/MHz                    |

|    |  |  |
|----|--|--|
| 1  |  |  |
| 2  | (ii) 10MHz system  |  |
| 3  | <u>offset frequency : <math>\Delta f</math></u>  | <u>Permissible level</u>                         |
| 4  | 15MHz or more and less than 25MHz,   | less than -22dBm/MHz                             |
| 5  |  |  |
| 6  | 3.2.3.7 Spurious emission (NT No.651, 2007)  |  |
| 7  | (1) Mobile terminal  |  |
| 8  | Frequency band   | Permissible Level                                |
| 9  | 9kHz or more and less than 150kHz,   | less than -13dBm/kHz                             |
| 10 | 150kHz or more and less than 30MHz,  | less than -13dBm/10kHz                           |
| 11 | 30MHz or more and less than 1000MHz,   | less than -13dBm/100kHz                          |
| 12 | 1000MHz or more and less than 2505MHz,   | less than -13dBm/MHz                             |
| 13 | 2505MHz or more and less than 2535MHz,   |  |
| 14 | For model-1  | less than -70dBm/MHz                             |
| 15 | For model-2  | less than -68dBm/MHz                             |
| 16 | For model-3  | less than -61dBm/MHz                             |
| 17 | 2535MHz or more and less than 2630MHz,   | less than -18dBm/MHz                             |
| 18 | 2630MHz or more and less than 2630.5MHz,   | less than $-13-8/3.5 \times (f-2627)$ dBm/MHz    |
| 19 | 2630.5MHz or more and less than 2640MHz,   | less than $-21-16/9.5 \times (f-2630.5)$ dBm/MHz |
| 20 | 2640MHz or more and less than 2655MHz,   | less than -37dBm/MHz                             |
| 21 | 2655MHz or more,   | less than -13dBm/MHz                             |
| 22 |  |  |
| 23 | Permissible level for 2535MHz or more and less than 2630MHz should be applied to the     |  |
| 24 | frequency range where a frequency offset from the center frequency of a carrier is equal |  |
| 25 | to or more than 2.5 times of the system frequency bandwidth.                             |  |
| 26 |  |  |
| 27 | (2) Base station   |  |
| 28 | Frequency band   | Permissible Level                                |
| 29 | 9kHz or more and less than 150kHz,   | less than -13dBm/kHz                             |
| 30 | 150kHz or more and less than 30MHz,  | less than -13dBm/10kHz                           |
| 31 | 30MHz or more and less than 1000MHz,   | less than -13dBm/100kHz                          |
| 32 | 1000MHz or more and less than 2505MHz,   | less than -13dBm/MHz                             |
| 33 | 2505MHz or more and less than 2535MHz,   | less than -42dBm/MHz                             |
| 34 | 2535MHz or more and less than 2630MHz,   | less than -13dBm/MHz                             |
| 35 | 2630MHz or more and less than 2634.75MHz,  | less than $-15-7/5 \times (f-2629.75)$ dBm/MHz   |



| <u>Spectrum band</u>                     | <u>Permissible level</u> |
|--|--------------------------|
| 1000MHz or less:                         | -54dBm/MHz               |
| More than 1000MHz and less than 2505MHz: | -47dBm/MHz               |
| 2505MHz or more and 2535MHz or less:     |                          |
| Model-1                                  | -62dBm/MHz               |
| Model-2                                  | -50dBm/MHz               |
| Model-3                                  | -47dBm/MHz               |

8

## 9 3.2.4 Receiver requirement for FWA equipment

## 10 3.2.4.1 Reception sensitivity

## 11 (1) Definition

12 The reception sensitivity shall be defined by the minimum receiver input level (dBm)  
13 which yields a bit error rate (BER) of  $1 \times 10^{-6}$  for QPSK under AWGN channel.

14 This is the definition for the specified reception sensitivity as well.

15

## 16 (2) Specification

## 17 5MHz bandwidth system

18 Mobile station: -91.3dBm or less

19 Base station: -91.3dBm or less

20

## 21 10MHz bandwidth system

22 Mobile station: -88.3dBm or less

23 Base station: -88.3dBm or less

24

## 25 3.2.4.2 Conducted Spurious (ORE, Article 24)

26 During reception mode, output power level at the antenna port shall not greater than  
27 following level.

28

## 29 Mobile station

| <u>Spectrum band</u>                  | <u>Permissible level</u> |
|---------------------------------------|--------------------------|
| 9kHz or more and less than 150kHz     | -54dBm/kHz               |
| 150kHz or more and less than 30MHz    | -54dBm/10kHz             |
| 30MHz or more and less than 1000MHz   | -54dBm/100kHz            |
| 1000MHz or more and less than 2505MHz | -47dBm/MHz               |

34

|    |                                       |                          |
|----|---------------------------------------|--------------------------|
| 1  | 2505MHz or more and 2535MHz or less;  |                          |
| 2  | Model-1                               | -70dBm/MHz               |
| 3  | Model-2                               | -68dBm/MHz               |
| 4  | Model-3                               | -61dBm/MHz               |
| 5  | More than 2535MHz                     | -47dBm/MHz               |
| 6  |                                       |                          |
| 7  | Base station                          |                          |
| 8  | (i) Antenna gain is 17dBi or less     |                          |
| 9  | <u>Spectrum band</u>                  | <u>Permissible level</u> |
| 10 | 1GHz or less                          | 4nW                      |
| 11 | More than 1GHz                        | 20nW                     |
| 12 |                                       |                          |
| 13 | (ii) Antenna gain is more than 17dBi  |                          |
| 14 | <u>Spectrum band</u>                  | <u>Permissible level</u> |
| 15 | 9kHz or more and less than 150kHz     | -54dBm/kHz               |
| 16 | 150kHz or more and less than 30MHz    | -54dBm/10kHz             |
| 17 | 30MHz or more and less than 1000MHz   | -54dBm/100kHz            |
| 18 | 1000MHz or more and less than 2505MHz | -47dBm/MHz               |
| 19 | 2505MHz or more and 2535MHz or less   | -61dBm/MHz               |
| 20 | More than 2535MHz                     | -47dBm/MHz               |

21

### 22 3.3 Low Power Repeater

23

24 This section applies only to the Mobile WiMAX repeaters, which complies with the  
 25 requirements for the blanket license in Japan. The Mobile WiMAX repeaters are utilized to  
 26 improve the radio access environments.

27 Unless otherwise stated, all requirements in this standard apply to both the uplink and  
 28 downlink directions.

29

#### 30 3.3.1 General Condition

31

##### 32 (1) Frequency and channel spacing

33 The operating frequency bands shall be 2.5GHz bands assigned for the BWA system  
 34 excluding the 20MHz system and the FWA system. The channel spacing shall be  
 35 5MHz or 10MHz.

## 1 (2) Type of Repeating

2 The repeater shall be of Non-regenerative and Generative repeating type.

3  
4 **Table 3-2 Type of Repeating**

| Type of Repeating  | Non-regenerative repeating   |                     | Generative repeating         |                     |
|--------------------|------------------------------|---------------------|------------------------------|---------------------|
| Relay frequency    | Same frequency               | Different frequency | Same frequency               | Different frequency |
| Number of channels | 3 channels (max)             |                     | 3 channels (max)             |                     |
| Configuration      | Integrated or separated type |                     | Integrated or separated type |                     |

5  
6 (3) Communications system

7 Time Division Duplex (TDD) system

## 8 (4) Multiplexing system

9 a. Toward Base station (upstream link)

10 Orthogonal Frequency Division Multiple Access (OFDMA) system

11 b. Toward Mobile station (downstream link)

12 Composite system using an Orthogonal Frequency Division Multiplexing  
13 (OFDM) system and a Time Division Multiplexing (TDM) system

## 14 (5) Modulation system (ORE, Article 49.28)

15 a. Toward Base station (upstream link)

16 QPSK, 16QAM or 64QAM

17 b. Toward Mobile station (downstream link)

18 BPSK, QPSK, 16QAM or 64QAM

## 19 (6) Transmission synchronization

20 a. Transmission burst repetition period

21  $5 \text{ ms} \pm 10\mu\text{s}$  or less22 b. The transmission burst lengths for Mobile stations and Base stations in Table  
23 3-3 (NT No.651,2007)

24

1                      **Table 3-3                      Maximum Permissible Transmission Burst Length**

| Maximum permissible transmission burst length [ms] |                     |
|--|---------------------|
| Toward Mobile station                              | Toward Base station |
| 3.65   | 1.35                |
| 3.55   | 1.45                |
| 3.45   | 1.55                |
| 3.35   | 1.65                |
| 3.25   | 1.75                |
| 3.15   | 1.85                |
| 3.05   | 1.95                |
| 2.95   | 2.05                |
| 2.85   | 2.15                |
| 2.75   | 2.25                |

- 2
- 3    **3.3.1.1 System condition**
- 4            (1) Maximum number of repeaters (in case of Non-regenerative repeating type)
- 5            Maximum number of repeaters per Base station shall be 100.
- 6            (2) Compliance with the radio protection guidelines
- 7            The repeater shall conform to the Regulations for Enforcement of the Radio Law,
- 8            Article 21.3 and Ordinance Regulating Radio Equipment, Article 14.2.

9

10   **3.3.2 Transmitter Requirement for Low Power Repeater**

- 11   **3.3.2.1 Frequency tolerance (ORE, Article 5, Table1)**
- 12            Downstream link (Toward Mobile station):      Within  $2 \times 10^{-6}$
- 13            Upstream link (Toward Base station):            Within  $2 \times 10^{-6}$

14

15   **3.3.2.2 Occupied band width (ORE, Article 6, Table 2)**

- 16            5 MHz system:            4.9 MHz or less
- 17            10 MHz system:            9.9 MHz or less

18

19   **3.3.2.3 Output power (ORE, Article 49.28)**

- 20            (1) Non-regenerative repeating
- 21            Downstream link (Toward Mobile station):      200mW or less\*
- 22            Upstream link (Toward Base station):            200mW or less\*

1           \*Total power is the aggregate of the output power of the downstream and upstream  
2 links. And the maximum number of the transmission channel is 3,when operated  
3 simultaneously.

4           (2) Regenerative repeating

5           Downstream link (Toward Mobile station):       Less than 200mW\*

6           Upstream link (Toward Base station):            Less than 200mW\*

7           \*Total power is the aggregate of the output power of the downstream and upstream  
8 links. And the maximum number of transmission channel is 3, when operated  
9 simultaneously.

10  
11   3.3.2.4 Output power tolerance (ORE, Article 14)

12           Downstream link (Toward Mobile station):       ±50%

13           Upstream link (Toward Base station):           ±50%

14  
15   3.3.2.5 Adjacent channel leakage power (NT No.651, 2007)

16           (1) Downstream link (Toward Mobile station)

17           (i) 5MHz system

18           Channel space:                                       5MHz

19           Occupied bandwidth :                               4.8MHz

20           Permissible adjacent channel leakage power:   2dBm or less

21           (ii) 10MHz system

22           Channel space:                                       10MHz

23           Occupied bandwidth :                               9.5MHz

24           Permissible adjacent channel leakage power:   0dBm or less

25           (2) Upstream link (Toward Base station)

26           (i) 5MHz system

27           Channel space:                                       5MHz

28           Occupied bandwidth :                               4.8MHz

29           Permissible adjacent channel leakage power:   2dBm or less

30           (ii) 10MHz system

31           Channel space:                                       10MHz

32           Occupied bandwidth :                               9.5MHz

33           Permissible adjacent channel leakage power:   0dBm or less

34

## 1 3.3.2.6 Spectrum mask (NT No.651, 2007)

## 2 (1) Downstream link (Toward Mobile station)

## 3 (i) 5MHz system

| 4 | <u>offset frequency : <math>\Delta f</math></u> | <u>Permissible level</u>                    |
|---|---|---|
| 5 | 7.5MHz or more and less than 8MHz,              | -20-2.28x( $\Delta f$ -7.5) dBm/MHz or less |
| 6 | 8MHz or more and less than 17.5MHz,             | -21-1.68x( $\Delta f$ -8) dBm/MHz or less   |
| 7 | 17.5MHz or more and less than 22.5MHz,          | -37 dBm/MHz or less                         |

8

## 9 (ii) 10MHz system

| 10 | <u>offset frequency : <math>\Delta f</math></u> | <u>Permissible level</u>                      |
|----|---|---|
| 11 | 15MHz or more and less than 20MHz,              | -21-32/19x( $\Delta f$ -10.5) dBm/MHz or less |
| 12 | 20MHz or more and less than 25MHz,              | -37 dBm/MHz or less                           |

13

## 14 (2) Upstream link (Toward Base station)

## 15 (i) 5MHz system

| 16 | <u>offset frequency : <math>\Delta f</math></u> | <u>Permissible level</u>                    |
|----|---|---|
| 17 | 7.5MHz or more and less than 8MHz,              | -20-2.28x( $\Delta f$ -7.5) dBm/MHz or less |
| 18 | 8MHz or more and less than 17.5MHz,             | -21-1.68x( $\Delta f$ -8) dBm/MHz or less   |
| 19 | 17.5MHz or more and less than 22.5MHz,          | -37 dBm/MHz or less                         |

20

## 21 (ii) 10MHz system

| 22 | <u>offset frequency : <math>\Delta f</math></u> | <u>Permissible level</u>                      |
|----|---|---|
| 23 | 15MHz or more and less than 20MHz,              | -21-32/19x( $\Delta f$ -10.5) dBm/MHz or less |
| 24 | 20MHz or more and less than 25MHz,              | -37 dBm/MHz or less                           |

25

## 26 3.3.2.7 Spurious emission (NT No.651, 2007)

## 27 (1) Downstream link (Toward Mobile station)

| 28 | Frequency band                         | Permissible Level         |
|----|--|---------------------------|
| 29 | 9kHz or more and less than 150kHz,     | -13dBm/kHz or less        |
| 30 | 150kHz or more and less than 30MHz,    | -13dBm/10kHz or less      |
| 31 | 30MHz or more and less than 1000MHz,   | -13dBm/100kHz or less     |
| 32 | 1000MHz or more and less than 2505MHz, | -13dBm/MHz or less        |
| 33 | 2505MHz or more and less than 2530MHz, | -37dBm/MHz or less        |
| 34 | 2530MHz or more and less than 2535MHz, | 1.7f-4338 dBm/MHz or less |
| 35 | 2535MHz or more and less than 2630MHz, | -18dBm/MHz or less *      |

|   |  |                                       |
|---|--|---------------------------------------|
| 1 | 2630MHz or more and less than 2630.5MHz, | -13-8/3.5x(f-2627) dBm/MHz or less    |
| 2 | 2630.5MHz or more and less than 2640MHz, | -21-16/9.5x(f-2630.5) dBm/MHz or less |
| 3 | 2640MHz or more and less than 2655MHz,   | -37 dBm/MHz or less                   |
| 4 | 2655MHz or more,                         | -13 dBm/MHz or less                   |

5

6 \*Permissible level for 2535MHz or above and below 2630MHz should be applied to the  
7 frequency range where the frequency offset from the center frequency of a carrier is equal to  
8 or larger than 2.5 times of the system frequency bandwidth

9

#### 10 (2) Upstream link (Toward Base station)

| 11 | Frequency band                           | Permissible Level                     |
|----|--|---------------------------------------|
| 12 | 9kHz or more and less than 150kHz,       | -13dBm/kHz or less                    |
| 13 | 150kHz or more and less than 30MHz,      | -13dBm/10kHz or less                  |
| 14 | 30MHz or more and less than 1000MHz,     | -13dBm/100kHz or less                 |
| 15 | 1000MHz or more and less than 2505MHz,   | -13dBm/MHz or less                    |
| 16 | 2505MHz or more and less than 2530MHz,   | -37dBm/MHz or less                    |
| 17 | 2530MHz or more and less than 2535MHz,   | 1.7f-4338 dBm/MHz or less             |
| 18 | 2535MHz or more and less than 2630MHz,   | -18dBm/MHz or less *                  |
| 19 | 2630MHz or more and less than 2630.5MHz, | -13-8/3.5x(f-2627) dBm/MHz or less    |
| 20 | 2630.5MHz or more and less than 2640MHz, | -21-16/9.5x(f-2630.5) dBm/MHz or less |
| 21 | 2640MHz or more and less than 2655MHz,   | -37 dBm/MHz or less                   |
| 22 | 2655MHz or more,                         | -13 dBm/MHz or less                   |

23

24 \*Permissible level for 2535MHz or above and below 2630MHz should be applied to the  
25 frequency range where the frequency offset from the center frequency of a carrier is equal to  
26 or more than 2.5 times of the system frequency bandwidth

27

#### 28 3.3.2.8 Standby output power (ORE,Article 49.28)

|    |  |                |
|----|--|----------------|
| 29 | Downstream link (Toward Mobile station): | -30dBm or less |
| 30 | Upstream link (Toward Base station):     | -30dBm or less |

31

#### 32 3.3.2.9 Antenna gain (ORE,Article 49.28)

|    |  |              |
|----|--|--------------|
| 33 | Downstream link (Toward Mobile station): | 2dBi or less |
| 34 | Upstream link (Toward Base station):     | 2dBi or less |

35

## 1 3.3.2.10 Cabinet radiation

2 Cabinet radiation in EIRP shall be 4nW/MHz or less or the value obtained by  
3 adding 0dBi to the permissible spurious emission\* in the spurious region measured  
4 at the antenna input terminal.

5 (\* Refer to subclause 3.3.2.7 for the spurious emission.)

6

## 7 3.3.2.11 Out of band gain (ORE Article 49.28)

8 In case of Non-regenerative repeating, out of band gain refers to the gain of the  
9 repeater outside the pass band. The gain outside the pass band shall not exceed the  
10 maximum level specified in the Table 3-4.

11

12

**Table 3-4 Out of band gain limits**

| Frequency Offset from the Edge Frequency, $f_{\text{offset}}$ | Maximum Gain |
|---|--------------|
| 5MHz  | 35dB         |
| 10MHz   | 20dB         |
| 40MHz   | 0dB          |

13

## 14 3.3.2.12 Intermodulation (NT No.651, 2007)

## 15 (1) 5 MHz System

16 Intermodulation emission generated by mixing the desirable emission within the regulated  
17 power limit and the disturbing waves at the  $\pm 5$ MHz offset and at the  $\pm 10$  MHz offset from the  
18 desired emission with powers of 30dB less than that of the desirable emission should be less  
19 than the permissible level of the spurious emission and adjacent channel leakage power.

20

## 21 (2) 10 MHz system

22 Intermodulation emission generated by mixing the desirable emission within the regulated  
23 power limit and the disturbing waves at the  $\pm 10$ MHz offset and at the  $\pm 20$  MHz offset from  
24 the desired emission with powers of 30dB less than that of the desirable emission should be  
25 less than the permissible level of the spurious emission and adjacent channel leakage power.

26

## 27 3.3.3 Receiver Requirement for Low Power Repeaters

## 28 3.3.3.1 Reception sensitivity (in case of Regenerative repeating type)

29 The reception sensitivity shall be defined by the minimum receiver input level (dBm)  
30 which yields the bit error rate (BER) of  $1 \times 10^{-6}$  for QPSK under AWGN channel.

1 This is the definition for the specified reception sensitivity as well.

2  
3 (1) Downstream link (Toward Mobile station)

4 5MHz system: -91.3dBm or less

5 10MHz system: -88.3dBm or less

6 (2) Upstream link (Toward Base station)

7 5MHz system: -91.3dBm or less

8 10MHz system: -88.3dBm or less

9  
10 3.3.3.2 Spurious response rejection ratio

11 The spurious response rejection ratio shall be defined as the level ratio of the  
12 interfering signal to the desired signal, specified by the following statement:

13 The level of the desired signal shall be set to +3 dB higher than the level of the specified  
14 reception sensitivity\*. The level of the interfering signal shall be the one yielding the  
15 bit error rate of  $1 \times 10^{-6}$  on the desired signal for QPSK. The interfering signal shall not  
16 be modulated.

17 (\* Refer to subclause 2.3.2.1 for the specified reception sensitivity.)

18  
19 (1) Downstream link (Toward Mobile station)

20 The spurious response rejection ratio shall be 11dB or more.

21 (2) Upstream link (Toward Base station)

22 The spurious response rejection ratio shall be 11dB or more.

23  
24 3.3.3.3 Adjacent signal selectivity

25 The adjacent signal selectivity shall be defined as the level ratio of the interfering  
26 signal to the desired signal, specified by the following statement:

27 The level of the desired signal shall be set to +3 dB higher than the level of the specified  
28 reception sensitivity\*. The level of the interfering signal shall be the one yielding the  
29 bit error rate of  $1 \times 10^{-6}$  on the desired signal for 16QAM . The interfering signal shall  
30 be 16QAM and tuned on the first adjacent channel.

31 (\* Refer to Section 2.3.2.1 for the specified reception sensitivity)

32  
33 (1) Downstream link (Toward Mobile station)

34 The adjacent signal selectivity shall be 11dB or more.

1 (2) Upstream link (Toward Base station)

2 The adjacent signal selectivity shall be 11dB or more.

3

4 3.3.3.4 Intermodulation performance

5 The intermodulation performance shall be defined as the level of the interfering signal,  
6 specified by the following statement:

7 The level of the desired signal shall be set to +3 dB higher than the level of the specified  
8 reception sensitivity\*. The respective level of the two interfering signals shall be the  
9 one yielding the bit error rate of  $1 \times 10^{-6}$  on the desired signal. The interfering signals  
10 shall be tuned on the first and second adjacent channel.

11 (\* Refer to Section 3.3.3.1 for the specified reception sensitivity)

12

13 (1) Downstream link (Toward Mobile station)

14 The non-modulated interfering signal on the first adjacent channel shall be  
15 -55dBm.

16 The modulated interfering signal on the second adjacent channel shall be -55dBm.

17 (2) Upstream link (Toward Base station)

18 The non-modulated interfering signal on the first adjacent channel shall be  
19 -55dBm.

20 The modulated interfering signal on the second adjacent channel shall be -55dBm.

21

22 3.3.3.5 Conducted Spurious (ORE, Article 24)

23 Less than 1GHz: 4nW or less

24 1GHz or more: 20nW or less

25

26 3.3.3.6 Requirements for Blanket License Application

27 The repeater shall be equipped with operation interruption function which is to  
28 stop repeating except the data signal is received from the Base stations or the  
29 Mobile stations of the BWA operator.

30

31 3.3.3.7 Requirements for Interference Avoidance to Other Radio Stations

32 The repeater shall be equipped with the runaway oscillation avoidance function  
33 which is to stop repeating in case the repeater emits distorted radio wave due to  
34 runaway oscillation.

35

## Chapter 4 System Profile

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The system profile of the 2.5 GHz Mobile WiMAX is defined in “WiMAX Forum™ Mobile System Profile” provided by WiMAX Forum as shown in Attachment 3 which is linked to the following electrical document.

### 4.1 Release 1.0

Attachment 3-1 wimax\_forum\_mobile\_system\_profile\_release\_1.0\_v1.40.pdf

### 4.2 Release 1.5

Attachment 3-2-1 WiMAX Forum™ Mobile System Profile Release 1.5 Common Part.pdf

Attachment 3-2-2 WiMAX Forum™ Mobile System Profile Release 1.5 TDD Part.pdf

Chapter 5 Network Architecture

The End-to-End Network Systems Architecture of the 2.5 GHz Mobile WiMAX is defined in “WiMAX forum network architecture Stage 2-3” provided by WiMAX Forum as shown in Attachment 4 which is linked to the following electrical documents.

5.1 Release 1.0

Attachment 4-1-1 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-2-Abbreviations.pdf

Attachment 4-1-2 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-2-Part 0.pdf

Attachment 4-1-3 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-2-Part 1.pdf

Attachment 4-1-4 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-2-Part 2.pdf

Attachment 4-1-5 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-2-Part 3.pdf

Attachment 4-1-6 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-2-WiMAX Interworking with DSL.pdf

Attachment 4-1-7 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-2-3GPP - WiMAX Interworking.pdf

Attachment 4-1-8 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-2-3GPP2 - WiMAX Interworking.pdf

Attachment 4-1-9 End-to-End Network Systems Architecture Stage 2 R1.1.0-Stage-3.pdf

Attachment 4-1-10 End-to-End Network Systems Architecture Stage 2

1 [R1.1.0-Stage-3-Annex- 3GPP-Interworking.pdf](#)

2  
3 [Attachment 4-1-11 End-to-End Network Systems Architecture Stage 2](#)

4 [R1.1.0-Stage-3-Annex- 3GPP2-Interworking.pdf](#)

5  
6 [Attachment 4-1-12 End-to-End Network Systems Architecture Stage 2](#)

7 [R1.1.0-Stage-3-Annex- Prepaid-Accounting.pdf](#)

8  
9 [Attachment 4-1-13 End-to-End Network Systems Architecture Stage 2](#)

10 [R1.1.0-Stage-3-Annex- R6-R8-ASN-Anchored-Mobility-Scenarios.pdf](#)

11  
12 5.2 Release 1.5

13  
14 [Attachment 4-2-1 WiMAX Forum® Network Architecture Detailed Protocols and](#)  
15 [Procedures Base Specification WMF-T33-001-R015v01.pdf](#)

16  
17 [Attachment 4-2-2 WiMAX Forum® Network Architecture Detailed Protocols and](#)  
18 [Procedures \[Informative Annex: Hooks and Principles for Evolution\]](#)  
19 [WMF-T33-004-R015v01.pdf](#)

20  
21 [Attachment 4-2-3 WiMAX Forum® Network Architecture Architecture, detailed](#)  
22 [Protocols and Procedures IP Multimedia Subsystem \(IMS\)](#)  
23 [Interworking WMF-T33-101-R015v01.pdf](#)

24  
25 [Attachment 4-2-4 WiMAX Forum® Network Architecture Architecture, detailed](#)  
26 [Protocols and Procedures Emergency Services Support](#)  
27 [WMF-T33-102-R015v02.pdf](#)

28  
29 [Attachment 4-2-5 WiMAX Forum® Network Architecture Architecture, detailed](#)  
30 [Protocols and Procedures WiMAX Over-The-Air General Provisioning](#)  
31 [System Specification WMF-T33-103-R015v02.pdf](#)

32  
33 [Attachment 4-2-6 WiMAX Forum® Network Architecture Architecture, detailed](#)  
34 [Protocols and Procedures WiMAX Over-The-Air Provisioning &](#)  
35 [Activation Protocol based on OMA DM Specifications](#)

- 1 [WMF-T33-104-R015v02.pdf](#)
- 2
- 3 [Attachment 4-2-7 WiMAX Forum® Network Architecture Architecture, detailed](#)  
4 [Protocols and Procedures Over-The-Air Provisioning & Activation](#)  
5 [Protocol based on TR-069 Specification WMF-T33-105-R015v01.pdf](#)  
6
- 7 [Attachment 4-2-8 WiMAX Forum® Network Architecture Architecture, detailed](#)  
8 [Protocols and Procedures WIMAX Lawful Intercept - NORTH](#)  
9 [AMERICAN REGION WMF-T33-107-R015v01.pdf](#)  
10
- 11 [Attachment 4-2-9 WiMAX Forum® Network Architecture Architecture, detailed](#)  
12 [Protocols and Procedures Robust Header Compression \(RoHC\)](#)  
13 [Support WMF-T33-108-R015v01.pdf](#)  
14
- 15 [Attachment 4-2-10 WiMAX Forum® Network Architecture Architecture, detailed](#)  
16 [Protocols and Procedures Policy and Charging Control](#)  
17 [WMF-T33-109-R015v01.pdf](#)  
18
- 19 [Attachment 4-2-11 WiMAX Forum® Network Architecture Protocols and Procedures for](#)  
20 [Location Based Services WMF-T33-110-R015v01.pdf](#)  
21
- 22 [Attachment 4-2-12 WiMAX Forum® Network Architecture System Requirements,](#)  
23 [Network Protocols and Architecture for Multi-cast Broad-cast](#)  
24 [Services \(MCBCS Subteams Common Sections\)](#)  
25 [WMF-T33-111-R015v01.pdf](#)  
26
- 27 [Attachment 4-2-13 WiMAX Forum® Network Architecture System Requirements,](#)  
28 [Network Protocols and Architecture for Multi-cast Broad-cast](#)  
29 [Services Dynamic Service Flow Based \(MCBCS – DSx\)](#)  
30 [WMF-T33-112-R015v01.pdf](#)  
31
- 32 [Attachment 4-2-14 WiMAX Forum® Network Architecture System Requirements,](#)  
33 [Network Protocols and Architecture for Multi-cast Broad-cast](#)  
34 [Services \(MCBCS Application Layer Approach\)](#)  
35 [WMF-T33-113-R015v01.pdf](#)

- 1
- 2     Attachment 4-2-15   WiMAX Forum® Network Architecture Architecture, detailed
- 3                     Protocols and Procedures WiMAX-SIM Application on UICC
- 4                     WMF-T33-114-R015v01.pdf
- 5
- 6     Attachment 4-2-16   WiMAX Forum® Network Architecture Universal Services Interface
- 7                     (USI) An Architecture for Internet+ Service Model
- 8                     WMF-T33-115-R015v01.pdf
- 9

Chapter 6 Measurement Method

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As for the items stipulated in Ordinance Concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment Appendix Table No.1 item 1(3), measurement methods are specified by MIC Notification (Note) or a method that surpasses or is equal to the method.

Note: This Notification refers to MIC Notification No.88 “The Testing Method for the Characteristics Examination”(January 26, 2004) as of the date of the revision of this standard version 1.0 (issued in December, 2007). Thereafter, the latest version of Notification would be applied if this Notification or contents of this Notification would be revised.

Attachment 1 List of Essential Industrial Property Rights

(selection of option 1)

| 特許出願人<br>PATENT HOLDER | 発明の名称<br>NAME OF PATENT | 出願番号等<br>REGISTRATION NO./ APPLICATION NO.<br>[Applied in Japan ] | 備考<br>(出願国名)<br>REMARKS |
|------------------------|-------------------------|---|-------------------------|
| (N/A)                  | (N/A)                   | (N/A)   | (N/A)                   |



## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER | 発明の名称<br>NAME OF PATENT  | 出願番号等<br>REGISTRATION NO./ APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS |
|------------------------|--|--|-------------------------|
| NOKIA Corporation *10  | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.1.0 |  |                         |
| NTT DoCoMo Inc. *10    | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.1.0 |  |                         |
| Motorola, Inc. *10     | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.1.0 |  |                         |
| Qualcomm Inc. *10      | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.1.0 |  |                         |
| FUJITSU LIMITED *10    | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.1.0 |  |                         |
| KDDI CORPORATION *10   | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.1.0 |  |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER | 発明の名称<br>NAME OF PATENT   | 出願番号等<br>REGISTRATION NO./<br>APPLICATION NO.  | 備考<br>(出願国名)<br>REMARKS |
|------------------------|---|--|-------------------------|
| NEC Corporation *10    | (1) 可変変調通信方法<br><br>(2) 多方向多重通信システムの送信出力電力制御方法<br><br>(3) 直交周波数分割多重変復調回路<br><br>(4) 送信電力制御方法、送信電力制御装置、移動局、基地局及び制御局<br><br>(5) 移動通信システム及び通信制御方法並びにそれに用いる基地局、<br>移動局<br><br>(6) 位置登録方法および位置登録方式 | 特許第2776094号<br><br>特許第2982724号<br><br>特許第3786129号<br><br>特許第3358565号<br><br>特許第3675433号<br><br>特許第2748871号 |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER | 発明の名称<br>NAME OF PATENT  | 出願番号等<br>REGISTRATION NO./APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS |
|------------------------|--|---|-------------------------|
| NTT DoCoMo Inc. *11    | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.1.1 |   |                         |

\*11: This patent is applied to the revised part of ARIB STD-T94 Ver.1.1.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

ARIB STD-T94

| 特許出願人<br>PATENT HOLDER | 発明の名称<br>NAME OF PATENT               | 出願番号等<br>REGISTRATION NO./<br>APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS  |
|------------------------|---------------------------------------|---|--|
| Motorola, Inc. *10     | パケット構造フィールドを有する通信システム                 | 特表平3-501079                                   | WO, AT, AU, BE, CH, DE, FR, GB, IT, KR, LU, NL, NO, SE, US                         |
|                        | 電話通信システムにおける加入者の真正証明および保護のための方法       | 特表平5-503816                                   | WO, AT, AU, BE, CA, CH, DE, DK, ES, FR, U, NL, SE                                  |
|                        | 時間領域パイロット成分を有する通信信号                   | 特表平5-501189                                   | WO, AT, AU, BE, BR, CA, CH, DE, DK, ES, FR, GB, GR, IT, KR, LU, NL, SE, US         |
|                        | 電気通信システムにおける加入者の真正証明及び保護のための方法        | 特表平5-508274                                   | WO, CA, US   |
|                        | QAM通信システムにおけるピーク対平均電力比の軽減方法           | 特表平6-504175                                   | WO, AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE, US                 |
|                        | 時間領域パイロット成分を有する通信信号                   | 特表平6-504176                                   | WO, AU, BR, CA, GB, KR   |
|                        | 通信システムにおいてデータ・ストリームの暗号化保護を提供する方法および装置 | 特表平8-503113                                   | WO, CA, FI, KR, AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, US |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER | 発明の名称<br>NAME OF PATENT                        | 出願番号等<br>REGISTRATION NO./<br>APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS   |
|------------------------|--|---|---|
| Motorola, Inc. *10     | ターボコード構造を使用する適応ハイブリッド<br>ARQ                   | 特表2003-515268                                 | WO, BR, CA, KR, AT, BE, CH, CY,<br>DE, DK, ES, FI, FR, GB, GR, IE, IT,<br>LU, MC, NL, PT, SE, TR, US  |
|                        | マルチチャネル・ストップ・アンド・ウェイト<br>ARQ通信のための方法および装置      | 特表2003-514486                                 | WO, BR, CA, KR, AT, BE, CH, CY,<br>DE, DK, ES, FI, FR, GB, GR, IE, IT,<br>LU, MC, NL, PT, SE, TR, US  |
|                        | 通信システムにおいて別個の順方向専用チャネル<br>及び共用制御チャネルを与える装置及び方法 | 特表2003-531534                                 | WO, AE, AG, AL, AM, AT, AU, AZ,<br>BA, BB, BG, BR, BY, BZ, CA, CH,<br>CN, CR, CU, CZ, DE, DK, DM, DZ,<br>EE, ES, FI, GB, GD, GE, GH, GM,<br>HR, HU, ID, IL, IN, IS, KE, KG, KP,<br>KR, KZ, LC, LK, LR, LS, LT, LU, LV,<br>MA, MD, MG, MK, MN, MW, MX,<br>MZ, NO, NZ, PL, PT, RO, RU, SD,<br>SE, SG, SI, SK, SL, TJ, TM, TR, TT,<br>TZ, UA, UG, UZ, VN, YU, ZA, ZW |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER | 発明の名称<br>NAME OF PATENT                    | 出願番号等<br>REGISTRATION NO./<br>APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS  |
|------------------------|--|---|--|
| Motorola, Inc. *10     | 広帯域の通信システム内で狭帯域の信号を送信<br>および受信するための方法および装置 | 特表2007-525930                                 | WO, AE, AG, AL, AM, AT, AU, AZ,<br>BA, BB, BG, BR, BW, BY, BZ, CA,<br>CH, CN, CO, CR, CU, CZ, DE, DK,<br>DM, DZ, EC, EE, EG, ES, FI, GB,<br>GD, GE, GH, GM, HR, HU, ID, IL,<br>IN, IS, KE, KG, KP, KR, KZ, LC, LK,<br>LR, LS, LT, LU, LV, MA, MD, MG,<br>MK, MN, MW, MX, MZ, NA, NI, NO,<br>NZ, OM, PG, PH, PL, PT, RO, RU,<br>SC, SD, SE, SG, SK, SL, SM, SY, TJ,<br>TM, TN, TR, TT, TZ, UA, UG, US,<br>UZ, VC, VN, YU, ZA, ZM, ZW                |
|                        | Multi-mode hybrid ARQ scheme               | WO2006055171A1                                | WO, AE, AG, AL, AM, AT, AU, AZ,<br>BA, BB, BG, BR, BW, BY, BZ, CA,<br>CH, CN, CO, CR, CU, CZ, DE, DK,<br>DM, DZ, EC, EE, EG, ES, FI, GB,<br>GD, GE, GH, GM, HR, HU, ID, IL,<br>IN, IS, JP, KE, KG, KP, KR, KZ, LC,<br>LK, LR, LS, LT, LU, LV, LY, MA,<br>MD, MG, MK, MN, MW, MX, MZ,<br>NA, NG, NI, NO, NZ, OM, PG, PH,<br>PL, PT, RO, RU, SC, SD, SE, SG, SK,<br>SL, SM, SY, TJ, TM, TN, TR, TT, TZ,<br>UA, UG, US, UZ, VC, VN, YU, ZA,<br>ZM, ZW |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER   | 発明の名称<br>NAME OF PATENT  | 出願番号等<br>REGISTRATION NO./<br>APPLICATION NO.   | 備考<br>(出願国名)<br>REMARKS |
|--------------------------|--|---|-------------------------|
| NOKIA<br>CORPORATION *10 | 多重アクセス通信システム及び多重アクセス通信方法、並びにその通信装置<br><br>無線電話システム、及び無線電話ネットワーク内でのデータ送信方法、無線電話器並びに固定局<br><br>無線電話TDMAシステムにおいてパケットデータを伝送するシステム<br><br>TDMAシステムにおける無線容量の動的割り振り方法<br><br>ハンドオーバー方法及びセルラ無線システム<br><br>情報の暗号化方法およびデータ通信システム | 特許第 3090300 号<br><br>特許第 3842805 号<br><br>特許第 3880642 号<br><br>特許第 3155010 号<br><br>特許第 3825049 号<br><br>特開 2006-262531 |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER   | 発明の名称<br>NAME OF PATENT   | 出願番号等<br>REGISTRATION NO./<br>APPLICATION NO.   | 備考<br>(出願国名)<br>REMARKS |
|--------------------------|---|---|-------------------------|
| NOKIA<br>CORPORATION *10 | <p>アイドルタイムを割り振る方法、移動及びネットワーク</p> <p>データ伝送を暗号処理する方法とその方法を利用するセルラ無線システム</p> <p>無線資源制御方法</p> <p>移動通信システムにおいてある複数プロトコルに従ってある複数層でデータを処理するための方法と装置</p> <p>複数アンテナ送信用の非ゼロ複素重み付けした空間-時間符号</p> <p>移動局の内部タイミングエラーを補償する方法及び回路</p> | <p>特許第 3943253 号</p> <p>特開 2006-271010</p> <p>特許第 3542705 号</p> <p>特許第 3445577 号</p> <p>特表 2005-503045</p> <p>特許第 3923571 号</p> |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)                       | 発明の名称<br>(NAME OF PATENT)  | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.)                | 備考<br>(出願国名)<br>REMARKS |
|--|--|---|-------------------------|
| KDDI株式会社 *10<br>株式会社KDDI研究所 *10<br>京セラ株式会社 *10 | (1) OFDM信号復調装置<br>(2) OFDM信号復調用シンボルタイミング検出回路<br>(3) OFDM受信装置の周波数及び位相誤差補正装置<br>(4) OFDM信号復調用シンボルタイミング検出方法及び装置 | 特願平11-159320<br>特願2000-022459<br>特願2000-070186<br>特願2000-246978 |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER) | 発明の名称<br>(NAME OF PATENT)  | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.)  | 備考<br>(出願国名)<br>REMARKS |
|--------------------------|--|---|-------------------------|
| KDDI株式会社 *10             | (5) 無線パケット通信システム及び基地局<br><br>(6) 多ビームセルラ無線基地局、移動機及びスペクトル拡散信号送信方法<br><br>(7) 無線基地局<br><br>(8) フレーム同期回路<br><br>(9) 直交周波数分割多重方式の受信装置及び受信方法<br><br>(10) OFDM信号の周波数誤差を補正する受信装置<br><br>(11) 伝搬路推定を行うOFDM受信装置 | 特願2000-368610<br>特許3731469<br>米国特許7012910<br><br>特願2001-115422<br><br>特願2001-190109<br><br>特願2002-037926<br>特許3826810<br><br>特願2002-114677<br>特許3846356<br><br>特願2002-135473<br>特許3885657<br><br>特願2002-229887<br>特許3791473 | US                      |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER) | 発明の名称<br>(NAME OF PATENT)  | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.)   | 備考<br>(出願国名)<br>REMARKS |
|--------------------------|--|--|-------------------------|
| KDDI株式会社 *10<br>小林英雄 *10 | (12) 伝送路特性推定装置および伝送路特性推定方法、無線復調装置、コンピュータプログラム<br><br>(13) 伝送路特性推定装置および伝送路特性推定方法、無線復調装置、コンピュータプログラム<br><br>(14) CNR推定装置、CNR推定方法、CNR推定プログラム、適応伝送無線システム、無線装置                        | 特願2002-373986<br><br>特願2003-025910<br><br>特願2003-067938  |                         |
| KDDI株式会社 *10             | (15) 伝送路特性推定装置、コンピュータプログラム受信装置及び受信方法<br><br>(16) 伝達関数推定装置及び、伝達関数推定方法<br><br>(17) 受信装置、送信装置<br><br>(18) 無線フレーム制御装置、無線通信装置及び無線フレーム制御方法<br><br>(19) 無線フレーム制御装置、無線フレーム制御方法、および無線通信装置 | 特願2003-204611<br><br>特願2006-082414<br><br>特願2006-094340<br><br>特願2006-192128<br><br>特願2007-93760 |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER) | 発明の名称<br>(NAME OF PATENT)          | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS           |
|--------------------------|------------------------------------|--|-----------------------------------|
| 三菱電機株式会社 *10             | データ伝送方法、データ受信方法、データ伝送システム、送信機及び受信機 | 特許第 3,895,745 号                                  | EP(DE,FR,IT,PT,GB),<br>US, CA, AU |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

Approved by the 73<sup>rd</sup> Standard Assembly

Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER     | 発明の名称<br>NAME OF PATENT  | 出願番号等<br>REGISTRATION NO./ APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS |
|----------------------------|--|--|-------------------------|
| 株式会社 日立コミュニケーションテクノロジー *10 | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.1.0 |  |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS  |
|------------------------------|---|--|--|
| QUALCOMM<br>Incorporated *10 | Method and apparatus for measuring channel state information                                    | JP2003-530010                                    | US, AU, BR, CA, EP, HK, ID, IL, IN, JP, KR, MX, NO, WO, RU, SG, TW, UA                                   |
|                              | Multiplexing of real time services and non-real time services for OFDM systems                  | JP2004-503181                                    | US, BR, CN, EP, HK, KR, TW, WO   |
|                              | Method and apparatus for utilizing channel state information in a wireless communication system | JP2005-502223                                    | US 6,771,706, US 20040165558, BE, BR, CN, DE, EP, ES, FI, FR, GB, HK, IE, IT, JP, KR, LU, NL, SE, TW, WO |
|                              | Rate selection for an OFDM system   | JP2005-533402                                    | US 7,012,883, US 20060087972, BR, CN, EP, HK, KR, TW, WO   |
|                              | Diversity Transmission Modes for MIMO OFDM Communication Systems                                | JP2005-531219                                    | US 7,095,709, US 20060193268, AU, BR, CA, CN, EP, HK, ID, IL, IN, KR, MX, NO, RU, SG, TW, UA, WO         |
|                              | Random Access for Wireless Multiple-Access Communication Systems                                | JP2006-504338                                    | US, AU, BR, CA, CN, EP, HK, ID, IL, IN, KR, MX, RU, TW, UA, WO   |
|                              | Reverse Link Automatic Repeat Request   | JP2006504337                                     | US, AU, BR, CA, CN, EP, HK, ID, IL, IN, KR, MX, RU, TW, UA, WO   |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS  |
|------------------------------|---|--|--|
| QUALCOMM<br>Incorporated *10 | MIMO System with Multiple Spatial<br>Multiplexing Modes   | JP2006-504339                                    | US 20040136349, US 12/115,522, US<br>12/115,523, AU, BR, CA, CN, EP,<br>HK, ID, IL, IN, KR, MX, RU, TW,<br>UA, WO  |
|                              | Transmit Diversity Processing for a<br>Multi-Antenna Communication System   | JP2006-504366                                    | US 7,002,900, US 20060039275, AU,<br>BR, CA, CN, EP, HK, ID, IL, IN, KR,<br>MX, RU, TW, UA, WO   |
|                              | A method and apparatus of using a single<br>channel to provide acknowledgement and<br>assignment messages   | JP2007-520169                                    | US, AU, CN, HK, IN, KR, WO   |
|                              | Shared signaling channel for a<br>communication system  | JP2008-507896                                    | US, CA, CL, CN, EP, HK, IN, KR,<br>MY, TW, WO  |
|                              | Apparatus and Method for Reducing Message<br>Collision Between Mobile Stations<br>Simultaneously Accessing a Base Station in a<br>CDMA Cellular Communications System | JP3152353  | US 5,544,196, US 6,615,050, AT, AU,<br>BE, BR, BG, CA, CH, DE, DK, KP,<br>EP, ES, FI, FR, GB, GR, HK, HU, IE,<br>IL, IT, KR, MX, NL, WO, CN, PT,<br>RU, ZA, SE, SK |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS  |
|------------------------------|---|--|--|
| QUALCOMM<br>Incorporated *10 | Method and apparatus for performing mobile assisted hard handoff between communications Systems                                     | JP2001-508625                                    | US, AM, AU, AZ, BR, BY, CA, CL, IL, DE, EPC, EP, ES, FI, FR, GB, HK, ID, IE, IN, IT, KG, KR, KZ, MD, MX, NL, NZ, WO, CN, TW, RU, ZA, SE, SG, TJ, TM, UA  |
|                              | Method and Apparatus for High Rate Packet Data Transmission   | JP2001522211                                     | US 7,079,550, US 20060280160, US 20070066320, US 20070019567, US 20070025267, AR, AT, AU, BE, BR, CA, CH, CL, CN, CY, CZ, EP, HK, NZ, DE, DK, ES, FI, FR, GB, GR, HU, ID, IE, IL, IN, IT, JP, KR, LU, MY, MC, MX, NL, NO, WO, PL, PT, RO, RU, ZA, SE, SG, UA, VN |
|                              | Method and Apparatus for Coordinating Transmission of Short Messages with Hard Handoff Searches in a Wireless Communications System | JP2002-514844                                    | AU, BR, US 20060120490, US 20070153941, CA, DE, EP, FI, FR, GB, HK, IL, IT, JP, KR, MX, NO, WO, CN, TW, SE, SG   |
|                              | Reservation Multiple Access   | JP2002-528017                                    | US, CN, EP, HK, KR, WO   |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)                                | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS |
|------------------------------|--|--|-------------------------|
| Panasonic<br>Corporation *10 | 直交周波数分割多重信号の伝送方法ならびにその送信装置および受信装置<br><br>受信装置、送信装置及び送信方法 | 特許第3539522号<br><br>特許第 3836019 号                 |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)  | 発明の名称<br>(NAME OF PATENT)                       | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.)                  | 備考<br>(出願国名)<br>REMARKS                              |
|---------------------------|---|---|--|
| 株式会社 日立コミュニケーションテクノロジー*10 | (1) 無線通信装置<br>(2) 同期配信方法<br>(3) 基地局<br>(4) 無線端末 | 特開2005-160035<br>特開2007-019960<br>特開2007-312435<br>特開 2007-312436 | CN, KR, US<br>CN, EP, US<br>CN, KR, US<br>CN, KR, US |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)  | 発明の名称<br>(NAME OF PATENT)    | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.)                      | 備考<br>(出願国名)<br>REMARKS   |
|---------------------------|------------------------------|---|---|
| Panasonic Corporation *10 | (1) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3008651 号<br>US09/677421<br>USRE40134<br>USRE40779                | JP<br>US<br>US<br>US  |
|                           | (2) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3061053 号   | JP  |
|                           | (3) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3061054 号   | JP  |
|                           | (4) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3109522 号<br>US6256357<br>US7302007<br>EP1039682<br><br>EP1330090 | JP<br>US<br>US<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL,LI<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL |
|                           | (5) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3114727 号   | JP  |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)  | 発明の名称<br>(NAME OF PATENT)         | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS   |
|---------------------------|-----------------------------------|--|---|
| Panasonic Corporation *10 | (6) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法  | 特許第 3154704 号<br>EP1039675<br><br>EP1330089      | JP<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL,LI<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL |
|                           | (7) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法  | 特許第 3154705 号<br>EP1049284<br><br>EP1330088      | JP<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL,LI<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE             |
|                           | (8) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法  | 特許第 3154706 号<br>EP1045541<br><br>EP01118510.5   | JP<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL,LI<br>EP   |
|                           | (9) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法  | 特許第 3154707 号<br>EP1039680                       | JP<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL  |
|                           | (10) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法 | 特許第 3154708 号<br>US7146092                       | JP<br>US  |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)  | 発明の名称<br>(NAME OF PATENT)         | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.)         | 備考<br>(出願国名)<br>REMARKS   |
|---------------------------|-----------------------------------|--|---|
| Panasonic Corporation *10 | (11) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法 | 特許第 3154709 号<br>US7280806                               | JP<br>US  |
|                           | (12) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法 | 特許第 3231035 号  | JP  |
|                           | (13) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法 | 特許第 3231036 号<br>US6728467<br>EP1035693<br><br>EP1439678 | JP<br>US<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL    |
|                           | (14) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法 | 特許第 3233625 号<br>US6724976<br>EP1035695<br><br>EP1439679 | JP<br>US<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL,LI<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL |
|                           | (15) 送信装置、受信装置、伝送装置、送信方法、<br>受信方法 | 特許第 3233626 号<br>EP1257104                               | JP<br>EP,IT,AT,BE,CH,DK,ES,GR,IE,PT,<br>SE,FR,DE,GE,NL  |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)  | 発明の名称<br>(NAME OF PATENT)     | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS |
|---------------------------|-------------------------------|--|-------------------------|
| Panasonic Corporation *10 | (16) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3248807 号                                    | JP                      |
|                           | (17) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3327914 号<br>US09/740068                     | JP<br>US                |
|                           | (18) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3327915 号                                    | JP                      |
|                           | (19) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3327916 号<br>US10/301737                     | JP<br>US                |
|                           | (20) 受信装置、受信方法                | 特許第 3359327 号                                    | JP                      |
|                           | (21) 送信装置、受信装置、伝送装置、送信方法、受信方法 | 特許第 3410085 号                                    | JP                      |
|                           | (22) 受信装置、受信方法                | 特許第 3588460 号                                    | JP                      |
|                           | (23) 受信装置、受信方法                | 特許第 3643834 号                                    | JP                      |
|                           | (24) 受信装置、受信方法                | 特許第 3643835 号                                    | JP                      |
| (25) 送信装置、受信装置、送信方法、受信方法  | 特許第 3829141 号                 | JP   |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER) | 発明の名称<br>(NAME OF PATENT)  | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS |
|--------------------------|----------------------------|--|-------------------------|
| NEC Corporation *10      | 移動無線通信におけるデータ伝送方式          | 特許第 2503888 号                                    | JP, US                  |
|                          | 移動通信システムのハンドオフ方法及び移動<br>端末 | 特許第 3120809 号                                    | JP                      |
|                          | 移動通信システムにおける基地局及び交換局       | 特許第 3214500 号                                    | JP                      |
|                          | 移動通信システムの送信電力制御方式          | 特許第 2823034 号                                    | JP                      |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

Approved by the 76<sup>th</sup> Standard Assembly

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER    | 発明の名称<br>NAME OF PATENT  | 出願番号等<br>REGISTRATION NO./ APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS |
|---------------------------|--|--|-------------------------|
| QUALCOMM Incorporated *20 | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.2.0 |  |                         |

\*20: This patent is applied to the part defined by ARIB STD-T94 Ver. 2.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)  | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS  |
|------------------------------|--|--|--|
| QUALCOMM<br>Incorporated *10 | Method and apparatus for adaptive transmission control in a high data rate communication system        | JP 2003-531518                                   | BR, CN, EP, FI, FR, DE, HK, IT, KR, NL, ES, SE, TW, GB, US 7,088,701   |
|                              | Method and apparatus for fast closed-loop rate adaptation in a high rate packet data transmission      | JP 2004-515932                                   | AU, BE, BR, CA, CN, EP, FI, FR, DE, HK, IN, ID, IE, IL, IT, JP, KR, MX, NL, NO, RU, SG, ES, SE, TW, UA, GB, US 7,245,594, US 20070064646, US 20070263655 |
|                              | Method and Apparatus for Multiplexing High-Speed Packet Data Transmission with Voice/Data Transmission | JP 4068455                                       | AU, BR, CA, CN, EP, HK, IN, ID, IL, JP, KR, MX, NO, RU, SG, TW, UA, US 6,775,254, US 20040240401   |
|                              | Method and apparatus for power control in a wireless communication system                              | JP 2004-510390                                   | BR, CN, EP, FR, DE, HK, IN, KR, NO, SG, TW, GB, US 6,801,759   |
|                              | Coding scheme for a wireless communication system  | JP 2004-535694                                   | BR, CN, EP, HK, KR, TW, US 6,961,388, US 20050276344   |
|                              | Power control for a channel with multiple formats in a communication system                            | JP 4505221                                       | CN, EP, HK, IN, JP, KR, TW, US 6,983,166, US 7,376,438, US 20080233995   |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS   |
|------------------------------|---|--|---|
| QUALCOMM<br>Incorporated *10 | Method and system for a multicast service initiation in a communication system                | JP 2005-533414                                   | BR, CN, EP, HK, JP, KR, TW,<br>US 6,876,636, US 20050169203   |
|                              | Multiplexing for a Multi-Carrier Cellular Communication System                                | JP 2008-503935                                   | AU, BR, CA, CL, CN, EG, EP, HK,<br>IN, ID, IL, JP, KR, MY, MX, NZ, NO,<br>PH, RU, SG, ZA, TW, UA,<br>US 7,724,777, US 20100195360, VN |
|                              | On-demand reverse-link pilot transmission   | JP 2008-546226                                   | AU, CA, CN, EP, HK, IN, ID, KR, NZ,<br>NO, PH, RU, UA, US 7,706,324,<br>US 20100238896, VN  |
|                              | Method and apparatus for reliable transmit power and timing control in wireless communication | JP 2009-508371                                   | CN, EP, IN, KR, TW,<br>US 20070054691   |
|                              | Neighbour cell measurements for cell re-selection   | JP 4465491                                       | EP, FI, FR, DE, JP, NL, GB,<br>US 6,377,803   |
|                              | Diversity transmitter and diversity transmission method                                       | JP 3978426                                       | CA, CN, EP, IN, ID, KR,<br>US 7,158,579, US 7,623,590,<br>US 20100098187  |
|                              | Transporting QoS Mapping Information in a Packet Radio Network                                | JP 3625769                                       | AU, BE, CA, CN, EP, FI, FR, DE, IT,<br>MX, ES, CH, GB, US 7,167,447,<br>US 20060126547  |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS  |
|------------------------------|---|--|--|
| QUALCOMM<br>Incorporated *10 | Measurement reporting in a telecommunication system   | JP 4122132                                       | CA, CN, EP, FI, FR, DE, HK, IT, NL, ES, SE, GB, US 7,003,290, US 7,499,701   |
|                              | A method for controlling connections to a mobile station  | JP 3515073                                       | BE, BR, CN, EP, FI, FR, DE, IT, JP, NL, ES, SE, GB, US 6,807,421, US 7,684,361   |
|                              | Method and apparatus for providing configurable layers and protocols in a communications system | JP 2003-524328                                   | AU, BR, CA, CN, EP, FI, FR, DE, HK, IN, ID, IL, IT, KR, MX, NL, NO, RU, SG, ES, SE, TW, UA, GB, US 6,539,030, US 7,106,779, US 7,158,537 |
|                              | Pilot signal transmission for an orthogonal frequency division wireless communication system    | JP 2008-533928                                   | BR, CA, CL, CN, EP, IN, KR, RU, SG, TW, TH, US 20060209670   |
|                              | Pilot signal transmission pattern for a multi-user OFDMA system                                 | WO 2010059650                                    | TW, US 20090213950   |
|                              | A technique for compressing a header field in a data packet                                     | JP 4159287                                       | AU, BE, BR, CA, CN, EP, FI, FR, DE, IN, IE, IT, JP, KR, MX, NL, RU, ES, SE, GB, US 6,680,955   |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS   |
|------------------------------|---|--|---|
| QUALCOMM<br>Incorporated *10 | Method and Apparatus for Correction and<br>Limitation of Transmitter Power on the<br>Reverse Link of a Mobile Radio Telephone<br>System | JP 3452930                                       | AU, BR, CA, CN, EP, FI, FR, DE,<br>HK, IN, ID, IT, KR, MX, RU, ES, SE,<br>GB, US 5,452,473, US 5,590,408,<br>US 5,655,220, VN |
|                              | Soft Handoff in a CDMA Cellular Telephone<br>System   | JP3014753  | AT, AU, BE, BR, CA, CH, CN, DE,<br>DK, EP, ES, FI, FR, GB, GR, HK, IN,<br>IL, IT, KR, LU, MY, MX, NL, NO,<br>TW, SE, SG, ZA   |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS  |
|------------------------------|---|--|--|
| QUALCOMM<br>Incorporated *20 | A Method of Providing a Gap Indication<br>During a Sticky Assignment                                    | JP 2008-507904                                   | AU, BR, CA, CL, CN, EP, HK, ID, IL,<br>IN, KR, MX, MY, NO, NZ, PH, RU,<br>SG, TH, UA, US 20060034173, VN |
|                              | Use of supplemental assignments   | JP 2008-533836                                   | AU, BR, CA, CL, CN, EP, HK, ID, IL,<br>IN, KR, MX, NO, NZ, PH, RU, SG,<br>TH, TW, UA, US 20060205414, VN |
|                              | Method of ciphering data transmission and<br>cellular radio system employing the method                 | JP 4555261                                       | AT, AU, BR, CN, DE, EP, ES, FI, FR,<br>GB, IN, IT, KR, NL, US 6,535,979                                  |
|                              | Use of supplemental assignments to<br>decrement resources   | JP 2008-541578                                   | AU, BR, CA, CN, EP, HK, ID, IL, IN,<br>KR, MX, NO, NZ, PH, RU, SG, SG,<br>UA, VN                         |
|                              | Method and apparatus for performing mobile<br>station assisted hard handoff using off line<br>searching | JP 4152587                                       | CN, DE, EP, FR, GB, HK, KR, TW,<br>US 6,134,440, ZA  |

\*20: These patents are applied to the part defined by ARIB STD-T94 Ver. 2.0.

Approved by the 80<sup>th</sup> Standard Assembly

Attachment 2 List of Essential Industrial Property Rights

(selection of option 2)

| 特許出願人<br>PATENT HOLDER    | 発明の名称<br>NAME OF PATENT  | 出願番号等<br>REGISTRATION NO./ APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS |
|---------------------------|--|--|-------------------------|
| QUALCOMM Incorporated *22 | A comprehensive confirmation form has been submitted with regard to ARIB STD-T94 Ver.2.2 |  |                         |

\*22: This patent is applied to the part defined by ARIB STD-T94 Ver. 2.2.

Reference (Not applied in Japan)

| 特許出願人<br>PATENT HOLDER   | 発明の名称<br>NAME OF PATENT  | 出願番号等<br>REGISTRATION NO./<br>APPLICATION NO. | 備考<br>(出願国名)<br>REMARKS |
|--|--|---|-------------------------|
| Motorola, Inc. *10   | Multiple user communication system, device and method with overlapping uplink carrier spectra                        | US5828660A                                    |                         |
|  | Synchronous coherent orthogonal frequency division multiplexing system, method, software and device                  | US5867478A                                    |                         |
|  | Multicarrier reverse link timing synchronization system, device and method   | US5802044A                                    |                         |
|  | Communication system having a packet structure field   | US4860003A                                    |                         |
|  | Method and apparatus for providing cryptographic protection of a data stream in a communication system               | US5319712A                                    |                         |
|  | Wideband signal synchronization  | US5272724A                                    |                         |
|  | Communication signal having a time domain pilot component  | US5519730A                                    |                         |
|  | Dynamic control of a data channel in a TDM wireless communication system   | US5598417A                                    |                         |
|  | Method for authentication and protection of subscribers in telecommunications systems                                | US5572193A                                    |                         |
|  | Communication unit and method for performing neighbor site measurements in a communication system                    | US6249678B1                                   |                         |
|  | Variable rate spread spectrum communication method and apparatus   | US6275488B1                                   |                         |
|  | Apparatus and method for providing separate forward dedicated and shared control channels in a communications system | US6934275B1                                   |                         |
|  | Multi-mode hybrid ARQ scheme   | US7096401B2                                   |                         |
|  | Adaptive hybrid ARQ using turbo code structure   | US6308294B1                                   |                         |
|  | Method and apparatus for transmission and reception of narrowband signals within a wideband communication system     | US7047006B2                                   |                         |
| Multi channel stop and wait ARQ communication method and apparatus | US7065068B2  |   |                         |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Reference (Not applied in Japan)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.)    | 備考<br>(出願国名)<br>REMARKS |
|------------------------------|---|---|-------------------------|
| QUALCOMM<br>Incorporated *10 | Mobile Station Assisted Soft Handoff in a<br>CDMA Cellular Communications System<br><br>Method and Apparatus for Utilizing Channel<br>State Information in a Wireless<br>Communication System<br><br>Remote Transmitter Power Control in a<br>Contention Based Multiple Access System | US5,640,414<br><br>US 7,006,848<br><br>US 5,604,730 | US 5,267,261            |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Reference (Not applied in Japan)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)  | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS |
|------------------------------|--|--|-------------------------|
| Panasonic<br>Corporation *10 | (26) Method of transmitting orthogonal frequency division multiplex signal, and transmitter and receiver employed therefor | US5682376<br>EP95119990                          | US<br>EP                |
|                              | (27) Transmitting apparatus, receiving apparatus, transmission method, and reception method                                | US7328389  | US                      |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

## Reference (Not applied in Japan)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)  | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.) | 備考<br>(出願国名)<br>REMARKS                           |
|------------------------------|--|--|---|
| QUALCOMM<br>Incorporated *10 | Enhanced Channel Interleaving for<br>Optimized Data Throughput         | US 6,987,778                                     | US 20060114910                                    |
|                              | Methods and apparatus for operating mobile<br>nodes in multiple states | US 6,788,963                                     | HK, TW  |
|                              | Data transmission in a TDMA system                                     | US 7,158,489                                     | AT, EP, FR, DE, GB                                |
|                              | Time division multiple access radio systems                            | US 6,967,943                                     | AU, AT, CN, EP, FI, FR, DE, IT, NL,<br>RU, SE, GB |
|                              | Message encoding with irregular graphing                               | US 6,163,870                                     |   |

\*10: These patents are applied to the part defined by ARIB STD-T94 Ver. 1.0.

Reference (Not applied in Japan)

| 特許出願人<br>(PATENT HOLDER)     | 発明の名称<br>(NAME OF PATENT)   | 出願番号等<br>(REGISTRATION NO. /<br>APPLICATION NO.)       | 備考<br>(出願国名)<br>REMARKS |
|------------------------------|---|--|-------------------------|
| QUALCOMM<br>Incorporated *20 | Apparatus and method for use in effecting<br>automatic repeat requests in wireless<br>multiple access communications systems<br><br>A method of providing a gap indication<br>during a sticky assignment<br><br>Use of supplemental assignments to<br>decrement resources | EP 1576837<br><br>US 20060164993<br><br>US 20070211668 | CA                      |

\*20: These patents are applied to the part defined by ARIB STD-T94 Ver. 2.0.



## Change History

| Version  | Date               | History                                     |
|----------|--------------------|---|
| Ver. 1.0 | December 12, 2007  | Enacted by the 68th ARIB Standard Assembly  |
| Ver. 1.1 | March 19, 2008     | Approved by the 69th ARIB Standard Assembly |
| Ver. 1.2 | June 6, 2008       | Approved by the 70th ARIB Standard Assembly |
| Ver. 1.3 | September 25, 2008 | Approved by the 71st ARIB Standard Assembly |
| Ver. 1.4 | March 18, 2009     | Approved by the 73rd ARIB Standard Assembly |
| Ver. 1.5 | July 29, 2009      | Approved by the 74th ARIB Standard Assembly |
| Ver. 2.0 | April 26, 2010     | Approved by the 76th ARIB Standard Assembly |
| Ver. 2.1 | March 28, 2011     | Approved by the 79th ARIB Standard Assembly |
| Ver. 2.2 | July 7, 2011       | Approved by the 80th ARIB Standard Assembly |

## Change History List of Standards Ver.1.1

| No. | Item No.     | Title   | Page         | Change Summary   |
|-----|--------------|---|--------------|--|
| 1   | Chapter 3.2  | (14), b, Note 3 and Note 2 (greater than 17dBi) | 31,32, 32a   | Addition of function on usage restriction for high gain antenna mobile station |
| 2   | Attachment 2 | Industrial Property Rights for Ver1.0           | AT2-4~ AT2-7 | Addition of IPR list   |

## Change History List of Standards Ver.1.2

| No. | Item No.     | Title                                 | Page    | Change Summary       |
|-----|--------------|---------------------------------------|---------|----------------------|
| 1   | Attachment 2 | Industrial Property Rights for Ver1.0 | AT2-8,9 | Addition of IPR list |

## Change History List of Standards Ver.1.3

| No. | Item No.     | Title                                 | Page            | Change Summary         |
|-----|--------------|---------------------------------------|-----------------|------------------------|
| 1   | Attachment 2 | Industrial Property Rights for Ver1.0 | AT2-10~ 13      | Addition of IPR list   |
| 2   | Attachment 2 | Industrial Property Rights for Ver1.0 | AT2-1~3 AT2-5~9 | Correction of footnote |

## Change History List of Standards Ver.1.4

| No. | Item No.     | Title                                 | Page       | Change Summary       |
|-----|--------------|---------------------------------------|------------|----------------------|
| 1   | Attachment 2 | Industrial Property Rights for Ver1.0 | AT2-14~ 18 | Addition of IPR list |

## Change History List of Standards Ver.1.5

| No. | Item No.     | Title                                 | Page       | Change Summary       |
|-----|--------------|---------------------------------------|------------|----------------------|
| 1   | Attachment 2 | Industrial Property Rights for Ver1.0 | AT2-19~ 25 | Addition of IPR list |

## Change History List of Standards Ver.2.0

| No. | Item No.    | Title  | Page | Change Summary  |
|-----|-------------|--|------|---|
| 1   | Chapter 2.5 | Enhancements in the WiMAX Forum System Profile Release 1.5 | 28   | Addition of description regarding enhancements in the WiMAX Forum System Profile Release 1.5                  |
| 2   | Chapter 2.6 | Low Power Repeater   | 29   | Addition of outline and configuration of Low Power Repeater   |
| 3   | Chapter 3.3 | Low Power Repeater   | 46   | Addition of technical requirements for Low Power Repeater   |
| 4   | Chapter 4.2 | Release 1.5  | 55   | Addition of Attachment 3-2-1"WiMAX Forum™ Mobile System Profile Release 1.5 Common Part" and Attachment 3-2-2 |

|   |              |                                       |         |   |
|---|--------------|---------------------------------------|---------|---|
|   |              |                                       |         | “WiMAX Forum™ Mobile System Profile Release 1.5 TDD Part”                       |
| 5 | Chapter5.2   | Release 1.5                           | 57      | Addition of Attachment 4-2-1 through 4-2-16 “WiMAX Forum™ Network Architecture” |
| 6 | Attachment 2 | Industrial Property Rights for Ver2.0 | AT2-24  | Addition of IPR list  |
| 7 | Reference    | List of Essential IPRs, Reference     | REF 1~3 | Separation of References (Not applied in Japan) from Attachment 2               |

#### Change History List of Standards Ver.2.1

| No. | Item No.     | Title  | Page      | Change Summary       |
|-----|--------------|--|-----------|----------------------|
| 1   | Attachment 2 | List of Essential IPRs for Ver1.0 and Ver2.0 | AT2-25~29 | Addition of IPR list |
| 2   | Reference    | List of Essential IPRs, Reference            | REF 4~5   | Addition of IPR list |

#### Change History List of Standards Ver.2.2

| No. | Item No.                 | Title   | Page   | Change Summary                         |
|-----|--------------------------|---|--------|--|
| 1   | Chapter 3.2 (4) a        | Modulation system (Mobile station)              | 30     | Addition of 64QAM                      |
| 2   | Chapter 3.2.1.3          | Output power (Mobile station)                   | 35     | Changed to “400mW or less”             |
| 3   | Chapter 3.2.1.5 (1) (i)  | Adjacent channel leakage power (Mobile station) | 35     | Changed to “5dBm or less”              |
| 4   | Chapter 3.2.1.5 (1) (ii) |   | 35     | Changed to “3dBm or less”              |
| 5   | Chapter 3.2.1.10         | Antenna gain (Mobile station)                   | 38     | Changed to “5dBi or less” with remarks |
| 6   | Chapter 3.3.1(5) a       | Modulation system (toward Base Station)         | 47     | Addition of 64QAM                      |
| 7   | Attachment 2             | Industrial Property Rights for Ver2.2           | AT2-30 | Addition of IPR list                   |



To: Secretariat of Standard Assembly Meeting of the Association of Radio Industries and Businesses  
 FAX: +81-3-3592-1103 E-mail:std@arib.or.jp  
 Nittochi Bldg. 11<sup>th</sup> Floor, 1-4-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013, Japan

## Communication Note of ARIB Standard-related Proposals, etc.

|                          |  |
|--------------------------|--|
| ARIB Standard Name (No.) | <b>OFDMA Broadband Mobile Wireless Access Systems<br/>(WiMAX™ applied in Japan)<br/>(ARIB STD-T94)</b> |
|--------------------------|--|

### Sections to be completed by sender

|       |      |       |
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OFDMA Broadband Mobile Wireless Access System  
(WiMAX™ applied in Japan)

ARIB STD-T94 Version 2.2

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|             |           |      |      |
|-------------|-----------|------|------|
| Version 1.0 | December  | 12th | 2007 |
| Version 1.1 | March     | 19th | 2008 |
| Version 1.2 | June      | 6th  | 2008 |
| Version 1.3 | September | 25th | 2008 |
| Version 1.4 | March     | 18th | 2009 |
| Version 1.5 | July      | 29th | 2009 |
| Version 2.0 | April     | 26th | 2010 |
| Version 2.1 | March     | 28th | 2011 |
| Version 2.2 | July      | 7th  | 2011 |

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