Mobile Broadband Wireless Access Systems (IEEE 802.20™ TDD Wideband and 625k-MC Modes Application in Japan)

ARIB STANDARD

ARIB STD-T97 Version 1.0

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Association of Radio Industries and Businesses

General Notes to the ARIB Standards and Technical Reports

3. The establishment, revision and abolishment of ARIB Standards and Technical Reports are approved at the ARIB Standard Assembly, which meets several times a year. Approved ARIB Standards and Technical Reports are made publicly available in hard copy, CDs or through web posting, generally in about one month after the date of approval.
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Preface

INTRODUCTION

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

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

An ARIB STANDARD herein is published as "Mobile Broadband Wireless Access Systems (IEEE 802.20™ TDD Wideband and 625k-MC Modes Application in Japan)". In order to ensure fairness and transparency in the defining stage, the standard was set by consensus of the standard council with participation of interested parties including radio equipment manufacturers, telecommunication operators, broadcasters, testing organizations, general users, etc. with impartiality.

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

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)

Contents

Chapter 1 General Descriptions

1.1 Outline

This ARIB STANDARD specifies requirements of the mobile broadband wireless access systems for the Japanese 2.5 GHz band operation. The requirements are compliant to the Regulation Articles 49.28 and 49.30 of the Ordinance Regulating Radio Equipment [1].

Also, this standard conforms to IEEE 802.20™ "The Standard for Local and Metropolitan Area Networks – Standard Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility – Physical and Media Access Control Layer Specification" [3].

The requirements were examined and specified to meet the Japan 2.5 GHz broadband wireless access (BWA) system operation. This standard, optimized for IP-transport, provides access capability for various vehicular mobility classes, very high peak rate, and spectral efficiency, seamless service capability for a wide-area mobile broadband wireless access system.

This standard consists of two TDD modes of operation, a Wideband mode and a 625k-MC mode, both of which have their own distinct and optimized MAC and PHY layers.

1.2 Scope of the Standard

This standard ensures that a compliant Access Terminal (AT) or User Terminal (UT) can obtain service through any Access Network (AN) or Base Station (BS) conforming to properly selected modes of this standard, consistent with equipment and operator requirements, also with satisfying coexistence requirements in the band with neighboring systems.

This standard specifies PHY and MAC layers and omits details concerning a particular Access Network implementation. However, it is designed to allow a fixed hierarchical backhaul structure or a more dynamic and non hierarchical backhaul structure as well.

Two TDD modes, a Wideband mode and a 625k-MC mode of the IEEE 802.20™ Standard [3], of operation are specified in this standard. Although the IEEE 802.20™ Wideband mode supports Frequency Division Duplex (FDD) and Time Division Duplex (TDD), this standard refers only to the TDD specification. The 625k-MC mode refers to all the IEEE 802.20™ 625k-MC mode specification.

A system overview is described in Chapter 2. Technical requirements defined in [1] and [2] are provided in Chapter 3. Air-interface specification can be referred by way in Chapter 4. Specific notes to the 1st version of this standard are shown in Chapter 5. Measurement method can be referred through Chapter 6.

1.3 References

[1] Japan MIC "The Ordinance Regulating Radio Equipment" (ORE) Article 49.28 and 49.30 (in Japanese)

[2] Notification of the Ministry of Internal Affairs and Communications (NT) No. 651, 2007

[3] IEEE Std 802.20™-2008, IEEE Standard for Local and metropolitan area networks Part 20: Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility - Physical and Media Access Control Layer Specification (URL: http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?tp=&isnumber=4618041&arnumber=4618042&punumber=4617930)

The Wideband and 625k-MC modes shall be compliant to [1] and [2] as specified in the Radio Law (Law No. 131 of 1950).

The Wideband mode is referred to the Article 49.28 in [1]. The 625k-MC mode is referred to the Article 49.30 in [1]. Both modes refer to [3] as the normative air-interface specification.

[Note] As of the issued date of this standard version 1.0, the regulations for this standard in [1] and [2] are specified with parameters of a draft version of the IEEE Standard [3]. Details are shown in Chapter 5.

1.4 Symbols and Abbreviations

ACK	Acknowledgement
AES	Advanced Encryption Standard
AN	Access Network
AT	Access Terminal
BCMCS	Broadcast-Multicast services
BS	Base Station
BWA	Broadband Wireless Access
CDMA	Code Division Multiple Access
CQI	Channel Quality Indicator
DFT	Discrete Fourier Transform
EAP	Extensible Authentication Protocol
FDD	Frequency Division Duplex
FDM	Frequency Division Multiplexing
FDMA	Frequency Division Multiple Access
FER	Frame Error Rate
FL	Forward Link
FLCS	Forward Link Control Segment

HARQ	Hybrid Automatic Repeat reQuest
HC-SDMA	High Capacity Spatial Division Multiple Access
IFFT	Inverse Fast Fourier Transform
i-HAP	IP-Handshake and Authentication Protocol
IP	Internet Protocol
i-TAP	IP-Terminal Authentication Protocol
LDPC	Low-Density Parity-Check
LLC	Logical Link Control
MAC	Media Access Control
MC	Multi-Carrier
MIB	Management Information Base
MIC	Ministry of Internal Affairs and Communications
MIMO	Multiple-Input Multiple-Output
NLOS	Non Line Of Site
NT	Notification of the Ministry of Internal Affairs and Communications
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
ORE	Ordinance Regulating Radio Equipment
PHY	Physical
PSK	Phase Shift Keying
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase-Shift Keying
QoS	Quality of Service
RL	Reverse Link
RLC	Radio Link Control
RLCS	Reverse Link Control Segment
ROHC	Robust Header Compression
SAR	Specific Absorption Rate
SDMA	Space Division Multiple Access
SINR	Signal to Interference plus Noise power Ratio
SISO	Single-Input Single-Output
TDD	Time Division Duplex
TDM	Time Division Multiplexing
UATI	Unicast Access Terminal Identifier
UT	User Terminal

Chapter 2 System Overview

This system overview is provided for informative purpose and is not a part of the specification.

2.1 Purpose and System Requirements

The specification in this standard was originally developed in the IEEE 802.20™ Working Group to enable worldwide deployment of cost effective, spectrum efficient, ubiquitous, always-on and interoperable multi-vendor mobile broadband wireless Access Networks. It will provide an efficient packet based air interface optimized for IP.

It intends to provide advanced system features and capabilities than those achieved by the existing mobile systems in terms of peak data rates, support for various vehicular mobility classes, higher spectral efficiencies, sustained user data rates and numbers of active users. Detailed system requirements that were originally specified in the IEEE 802.20™ Working Group can be found in "IEEE 802.20™ PD-02 Mobile Broadband Wireless Access Systems: Approved PAR" (02/12/11).

Only TDD specification of the IEEE 802.20™ Standard is referenced in this standard without any change, which meets the Japanese 2.5 GHz band BWA technical requirements [1].

2.2 Wideband Mode

For the Wideband mode, the specifications in this standard refer only to TDD specification of the IEEE 802.20™ Standard.

2.2.1 Architecture Reference Model

Figure 2-1 shows a Wideband mode architecture reference model. The Wideband mode configures "Multiple Routes" (unique paths) between the Access Terminal and the Access Network. An Access Network consists of the physical device that is referred as "Access Node" in [3], which implements the PHY and MAC protocols of one or more sectors. The Access Terminal communicates with one or more Access Networks over the air interface. The Access Terminal maintains an In-Use protocol stack instance called a "Route" associated with each Access Network that it is in communication with. The Access Terminal may be served by one sector per Forward or Reverse Link. Handoff is performed independently on Forward Link and Reverse Link.

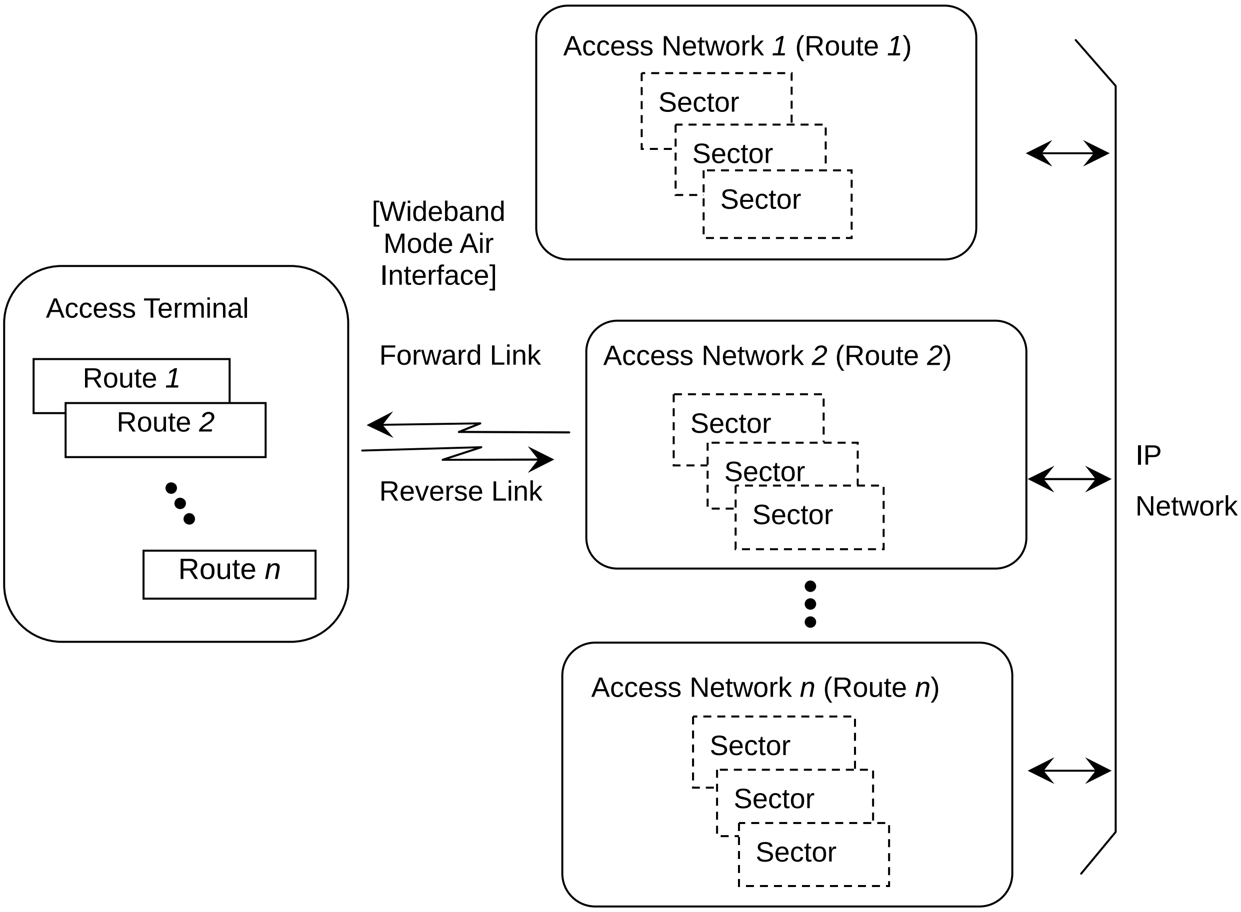


Figure 2-1 Wideband Mode Architecture Reference Model

2.2.2 Wideband Mode System Aspects

(1) Multiplexing, Access Method, Coding, Modulation, and Packet Format

The physical layer consists of OFDM symbols having 9.6 kHz subcarrier spacing. It uses OFDMA on the forward link and a combination of OFDMA for the data channel and code division multiple access (CDMA) for some of the reverse link control channels. Flexible bandwidth deployment from 5 MHz to 20 MHz is supported. In addition, operators can utilize bandwidth flexibility using variable guard carriers. Bandwidth can be scaled in units of ~154 kHz. The air-interface is designed for robust operation with frequency reuse = 1. No frequency planning is required.

Several coding schemes are supported. A rate-1/3 convolutional code is used to encode short packets in which the number of information bits is less than or equal to 128. A rate-1/5 turbo code is used to encode packets (or subpackets) in which the number of information bits is greater than 128. Optional LDPC codes are allowed for low complexity decoding of very high data rate.

Four modulation formats (QPSK, 8PSK, 16QAM and 64QAM) are supported in the air-link. The system supports 15 packet formats on the forward link as well as on the reverse link. The number of bits in a physical layer transmission is determined by the number of subcarriers assigned for the transmission, and the packet format chosen.

(2) Frame and Hybrid ARQ Interlace Structures

Forward and reverse link transmissions are divided into units of superframes. Each superframe is further divided into units of PHY frames. The frame structure of the system defines the timing of FL and RL PHY frames within a superframe. Additionally, it defines the relative timing of assignments, acknowledgements, and eight-interlace HARQ retransmissions associated with a data packet. This structure is designed to minimize latency of data transmissions while maintaining acceptable processing durations for encoding and decoding at the AT (Access Terminal) and the AN (Access Network), as well as scheduling at the AN.

As illustrated in Figure 2-2, a forward link superframe consists of a superframe preamble followed by 12 FL PHY frames, and a reverse link superframe consists of 12 RL PHY frames. The superframe preamble carries acquisition sequences and key overhead parameters that enable an AT to receive the forward link control channels and subsequently access the system. The first RL PHY frame of each FDD RL superframe is lengthened by the duration of the FL superframe preamble to ensure superframe timing alignment between the forward link and reverse link.

(3) Superframe Preamble

The superframes enable low overhead signaling in the air-link. The superframe preamble carries broadcast system information, which consists of 8 OFDM symbols as shown in Figure 2-2.

Fast system acquisitions are enabled by hierarchical pilot search. The last three OFDM symbols in the superframe preamble (the symbols indexed 5 through 7) are TDM pilots which are used for initial acquisition. TDM1 (F-ACQCH: Acquisition Channel) is used for initial timing and frequency acquisition. Every sector transmits the same TDM1 waveform. TDM2 carries Pilot-PN (Sector ID by 512 different Walsh sequences). TDM2 is used to search for sectors based on results of TDM1 search. TDM3 carries information assisting in system determination.

Primary Broadcast Control Channel (F-PBCCH) carries deployment specific information (FFT size, CP size, superframe index, etc). Secondary Broadcast Control

Channel (F-SBCCH) carries sector specific information (FL Hopping Structure, FL Pilot Structure, FL Control Channel Structure, Number of Effective Tx Antennas, etc). Quick Paging Channel (F-QPCH) for fast paging notification and F-SBCCH are sent in alternate superframes. Other Sector Interference Channel (F-OSICH) indication is sent on phase difference of TDM2 and TDM3.

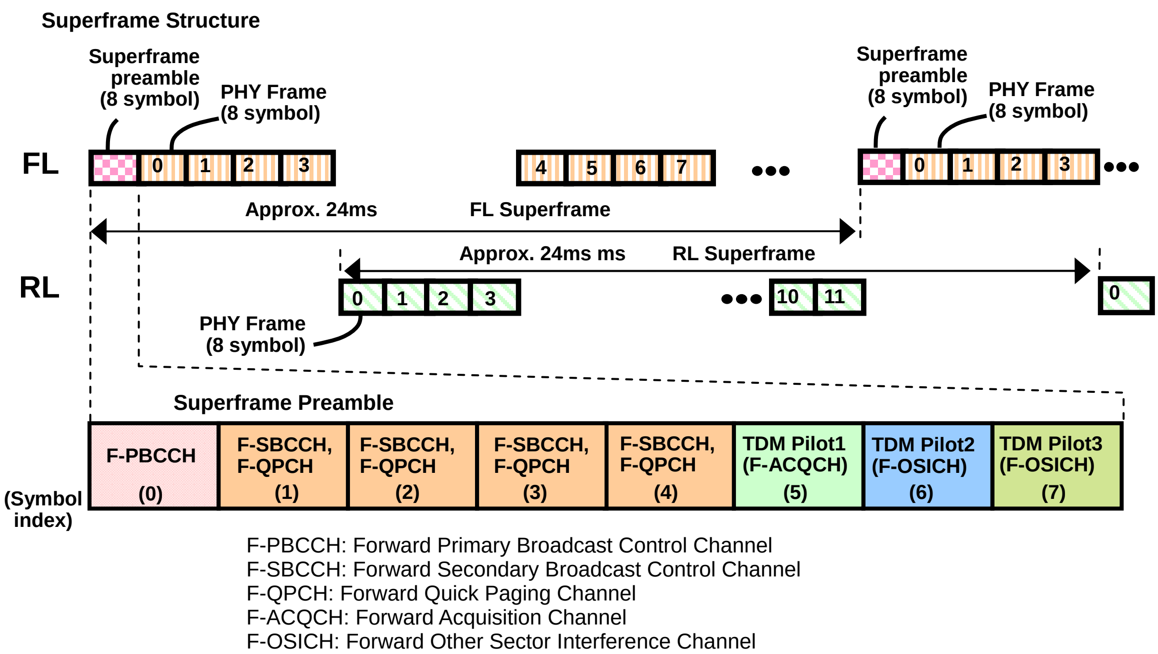


Figure 2-2 Superframe Structure Example

(4) Forward Link Control Channels

FL control channels other than Superframe preambles are transmitted on FL Control Segment (FLCS), which are hopped in PHY frames. FLCS includes FL PHY layer channels:

– F-SCCH: Shared Control Channel
– F-PCCH: Power Control Channel
– F-PQICH: Pilot Quality Indicator Channel
– F-FOSICH: Fast Other Sector Interference Channel.
– F-IOTCH: IoT Channel.
– F-ACKCH: Carries ACK Channel in response to RL traffic
– F-SPCH: Start of Packet Channel.

FLCS allows flexible signaling overhead in each PHY frame and enables variable and low control resource allocation with fine granularity.

(5) Reverse Link Control Channels

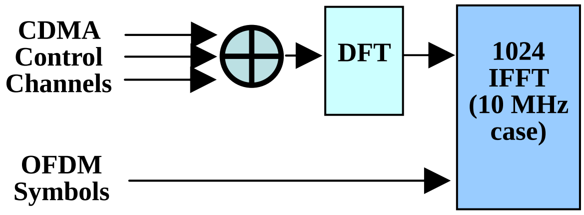
RL control segment (RLCS) adopts a design based on a combination of OFDMA and CDMA. RL OFDMA control segment is used for periodic and reliable feedback channels. CDMA control segment allows for statistical multiplexing enabling very low-latency transmissions with minimal overhead. Thus, Access, Bandwidth request, and Handoff request channels are sent in CDMA control segment. RL CDMA control segment may consist of multiple subsegments. Each CDMA subsegment size is 128 contiguous subcarriers over 8 OFDM symbols. All cells in a deployment use the same subsegment assignments that hop over the entire bandwidth in a cyclical way for diversity. Waveform generation diagram is shown in Figure 2-3. RL OFDMA and CDMA control segments allow flexible control overhead versus latency tradeoff.

CDMA control subsegment includes PHY layer channels:

- R-ACH: Access Channel
- R-PICH: Pilot Channel
- R-CDCCH: CDMA Dedicated Control Channel. The following different logical channel can be multiplexed on a single R-CDCCH:
  - R-CQICH (Channel Quality Indicator Channel, also used for FL handoff request)
  - R-REQCH (BandWidth REquest Channel, also used for RL handoff request)
  - R-PAHCH (Power Amplifier Headroom Channel),
  - R-PSDCH (ChanDiff (relative strength of each AN) report)

OFDMA control subsegment includes PHY layer channels:

- R-ACKCH: ACK Channel
- R-DPICH: Dedicated Pilot Channel
- R-ODCCH: OFDMA Dedicated Control Channel. R-ODCCH may carry the following RL logical channels:
  - R-CQICH
  - R-REQCH
  - R-MQICH (MIMO CQI feedback)
  - R-BFCH (Beam index and SDMA related feedback)



- The waveforms corresponding to different CDMA control channels are first generated in the time-domain.
- The time-domain waveforms are then added together and the resulting waveform is converted to the frequency domain.
- The resulting frequency-domain sequence is then mapped to the subcarriers of an OFDM symbol that are assigned to the CDMA subsegment for the AT.

Figure 2-3 CDMA Control Segment Generation

(6) MIMO, SDMA, and Beamforming Support

SISO (Single-Input Single-Output) and MIMO users are supported simultaneously. MIMO enables very high data rate transmissions to users close to the AN. Beamforming increases user data rates by focusing the transmit power to the direction of the user, enabling higher receive SINR (Signal-to-Interference and Noise power Ratio) at the AT. SDMA increases sector capacity by allowing simultaneous transmissions to multiple users that can be spatially separated. Beamforming along with MIMO and SDMA provides higher user data rates at both high and low SINR regions.

(7) Active Set, Session Anchor Access Network, and Serving Access Network

The Access Terminal keeps a list of best visible sectors in a list called Active Set. The Active Set is maintained by both the Access Terminal and Access Network. It consists of sectors that the AT may choose to switch to at any time. At any given time, the Access Terminal may be served by one sector (serving sector) per Forward or Reverse Link. The sector can be different for FL and RL and it changes based on radio conditions. At any given time only one Access Network provides connectivity to the Internet for a given Access Terminal. The Access Network that contains the serving sector is called the Serving Access Network.

In the 802.20™ Wideband mode, the Access Terminal receives service by one or more Access Networks. Each Access Network may have one or more sectors to better utilize the air link resources. An Access Network that does not communicate with the Access

Terminal can communicate with the Access Terminal through the Serving Access Network.

The Access Network providing Internet connectivity is called the Session Anchor Access Network. It may be changed to minimize the number of Access Networks that the packet has to travel before reaching the AT.

Figure 2-4 shows concept of Session Anchor Access Network and Serving Access Network.

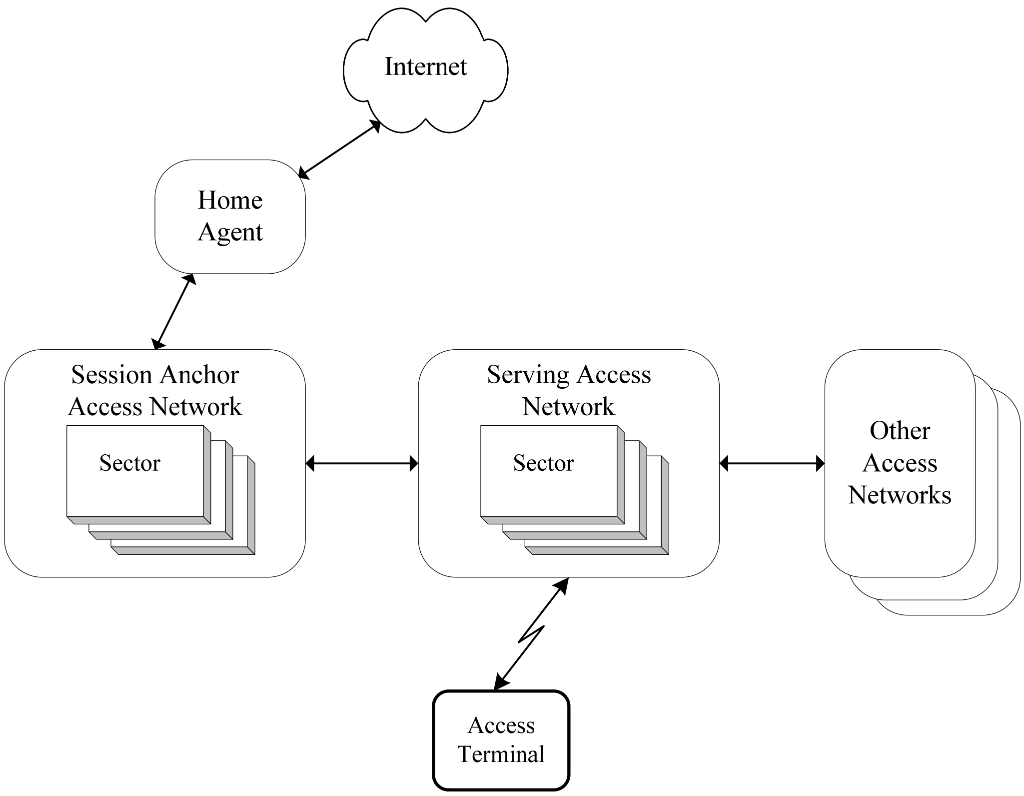


Figure 2-4 Session Anchor Access Network and Serving Access Network

2.3 625k-MC Mode

This 625k-MC mode is an enhancement of ANSI ATIS-0700004.2005, High Capacity-Spatial Division Multiple Access (HC-SDMA) Radio Interface Standard September, 2005. Unless otherwise specified in this document, the specifications of ATIS-0700004.2005 shall apply to the 625k-MC mode of 802.20™.

2.3.1 Architecture Reference Model

The architecture reference model for 625k-MC Mode is presented in Figure 2-5. The reference model includes the air interface between the User Terminal and the Access Network.

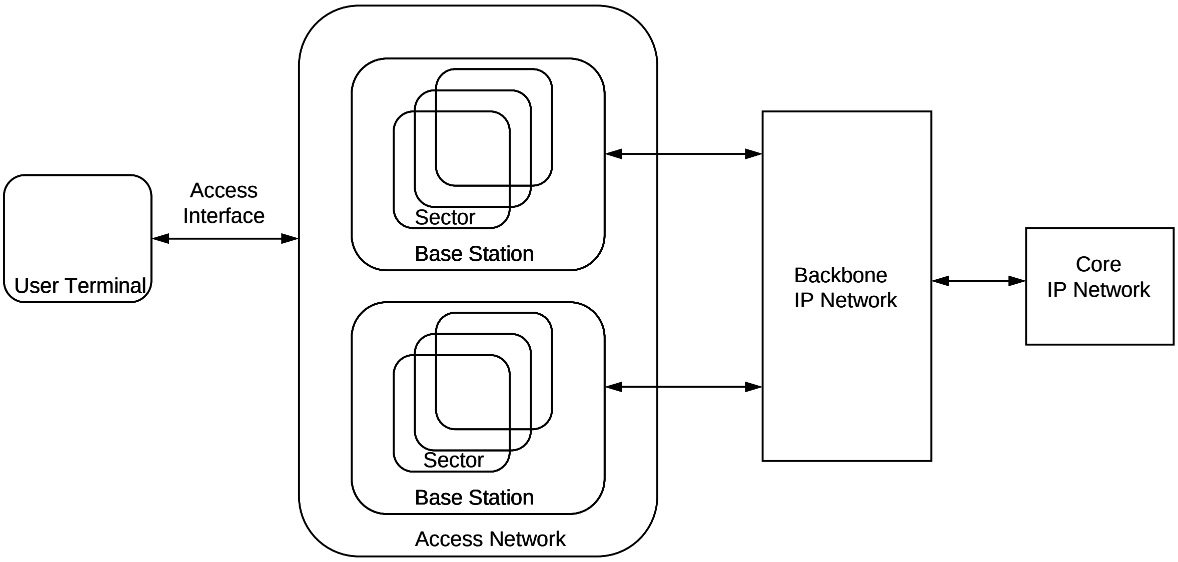


Figure 2-5 Architecture reference model

2.3.2 625k-MC Mode System Aspects

The 625k-MC mode, which is uniquely designed around multiple antennas with spatial processing and spatial division multiple access (SDMA), enables the transfer of IP traffic, including Broadband IP Data, over a layered reference model as shown in Figure 2-5. The Physical (PHY) and Data Link Layers (MAC , LLC and RLC) are optimally tailored to derive maximum benefit from spatial processing technologies: Adaptive Antenna Processing and SDMA: Enhanced spectral efficiency and capacity, and wider coverage while enabling the economic operation even when the available spectrum is as small as 625 kHz. Secondly, the Physical and Data Link Layers support higher data rates and throughputs by enabling multiple 625 kHz carrier aggregation – hence the name "625k-MC mode".

The physical aspects of the protocol are arranged to provide spatial training data, and correlated uplink and downlink interference environments, for logical channels amenable to directional transmission and reception such as traffic channels. Conversely, channels not amenable to directional processing, such as paging and broadcast channels, have smaller payloads and receive a greater degree of error protection to balance their links with those of the directionally processed channels. Adaptive modulation and channel coding, along with uplink and downlink power control, are incorporated to provide reliable transmission across a wide range of link conditions. Modulation, coding and power control are complemented by a fast ARQ mechanism to provide as reliable link as is possible in a mobile setting. Fast, low-overhead, make-before-break inter-cell handover is also supported. Differentiated and tiered services are enabled through a flexible Quality of Service (QoS) mechanism. Security for the radio access link is provided by mutual authentication of the terminals and access network, and by encryption to ensure data privacy.

The 625k-MC mode's Physical layer, corresponding to the Physical Layer of ATIS-0700004.2005, is characterized by a TDD/TDMA structure with 5 ms frames, each frame containing three uplink and three downlink bursts (timeslots) as shown in Figure 2-6.

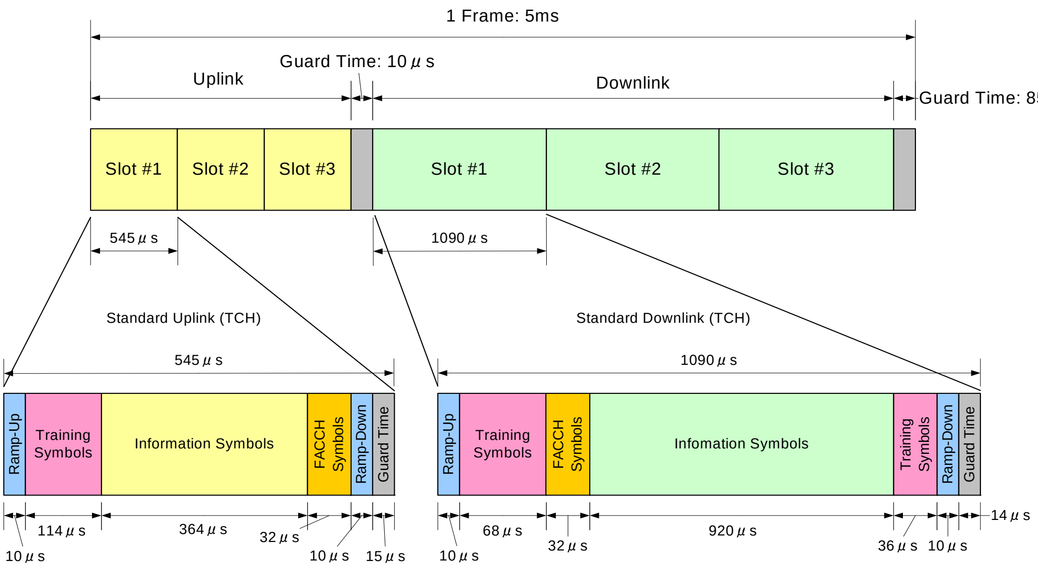


Figure 2-6 TDMA-TDD Frame Structure of 625k-MC Mode

The air interface's logical channels are all mapped onto this structure. In order to provide high spectral efficiency, many aspects of Physical Layer are specifically designed to support the effective use of adaptive antenna arrays. For instance, training sequences for Spatial Division Multiple Access (SDMA) are incorporated in certain burst structures.

Uplink and downlink symbol rates are 500 kSymbols/s in all circumstances and a 25% root-raised cosine filter is employed, which leads to a 625 kHz carrier spacing. A single user may aggregate multiple 625 kHz carriers.

The basic physical resource in the system is a spatial channel, which consists of a carrier, an uplink and downlink timeslot pair, and a spatial channel index. Multiple antennas and adaptive antenna processing make it possible to support multiple spatial channels simultaneously on the same conventional channel.

A range of modulation and coding combinations (referred to as "ModClasses") are employed to maximize throughput subject to FER and link conditions. Independent uplink and downlink power control and ModClass adaptation are to be performed on a burst-by-burst basis on traffic channels. Channels that have lower spatial processing gain, such as broadcast and paging channels, are transmitted with more extensive channel coding than traffic channels, balancing the tolerable path loss for all channel types. The PHY layer employs spatial processing, multiple modulation and channel coding formats, and equalization with per-burst training data to manage the RF challenges of a mobile Non-Line-of-Sight (NLOS) environment.

Chapter 3 Technical Requirements of the Systems and Equipment

This chapter provides the regulations and associated technical requirements regarding the radio equipment of the ARIB STD-T97 systems. The requirements are intended for the use in the Japanese 2.5 GHz band, which are provisions written in Japanese in the regulations in MIC Ordinances and related Notifications shown in the references in Section 1.3.

The original regulation in Japanese prevails if any ambiguity is found between the requirements in this chapter and the original regulations.

3.1 Wideband Mode

3.1.1 Radio Equipment

The following is assumed for the radio equipment:

a) Access Terminal

b) Access Network

[Note] “Access Network” refers to the network equipment that implements the PHY and MAC protocols. The physical device of the Access Network is referred as “Access Node” in [3]. Access Network provides data connectivity between a packet switched data network (typically the Internet) and the Access Terminals. “Sector” refers to the part of the Access Network that provides data connectivity to the Access Terminals. See section 2.2.

3.1.2 General Requirements

3.1.2.1 Duplex method (ORE, Article 49.28)

TDD (Time Division Duplex)

3.1.2.2 Frequency band (NT No.651, 2007)

2545 MHz - 2575 MHz, 2595 MHz - 2625 MHz

3.1.2.3 Multiplexing method (ORE, Article 49.28)

Reverse Link (The radio connection with the AT transmitting and the AN receiving):

OFDMA（Orthogonal Frequency Division Multiple Access）

Forward Link (The radio connection with the AN transmitting and the AT receiving):

OFDM（Orthogonal Frequency Division Multiplexing）

3.1.2.4 Modulation (ORE, Article 49.28)

Reverse Link:

QPSK, 8PSK, 16QAM, 64QAM

Forward Link:

QPSK, 8PSK, 16QAM, 64QAM

3.1.2.5 Transmission timing and synchronization

(1) FL:RL time-partitioning ratio in number of frames (ORE, Article 49.28)

M : N (M,N = integer. Default scheme is 1:1 or 2:1)

[Note] Only the cases of (M, N) = (4, 4) and (M, N) = (6 : 3) are applicable in STD-T97 Ver. 1.0. (See Chapter 5)

(2) Transmitted burst length (ORE, Article 49.28)

Reverse Link: 911.46 x N μs

Forward Link: Tx Burst Length without Preamble is 911.46 x M μs

Tx Burst Length with Preamble is 1070 + 911.46 x M μs

[Note] Only the cases of (M, N) = (4, 4) and (M, N) = (6 : 3) are applicable in STD-T97 Ver. 1.0. See Chapter 5 for detail.

[Note] Although the other burst lengths are specified in [3], only above is applicable in STD-T97 Ver. 1.0. The other burst lengths are going to be applicable after upcoming revision of the ORE. See Chapter 5 for detail.

(3) Transmitted burst repetition period

AN repeats transmitting a FL frame that is synchronized to the GPS time reference source with synchronization tolerance of ±10 μs.

Burst repetition period for Preamble, FL frames, and RL frame:

1070 + 911.46 x M + 78.12 + 911.46 x N + 16.28 μs, where a preamble is sent out in FL, followed by M FL frames and N RL frames. M + N = 24.

[Note] Only the cases of (M, N) = (4, 4) and (M, N) = (6 : 3) are applicable in STD-T97 Ver. 1.0. See Chapter 5 for detail.

[Note] Although the other burst lengths are specified in [3], only above is applicable in STD-T97 Ver. 1.0. The other burst lengths are going to be applicable after upcoming revision of the ORE. See Chapter 5 for detail.

3.1.2.6 Authentication, encryption, information security measure

To prevent unauthorized use of the system, secured protection measures such as user identification by mobile equipment number, user authentication, transmission data encryption, shall be applied as needed.

3.1.2.7 Electro-Magnetic Compatibility and Protection

In order to mitigate electro magnetic interference between a mobile terminal and a car-mounted electronic device and / or a medical electronic device, adequate measures shall be taken in the equipment.

3.1.2.8 Compliance to the radio protection policy

The Access Terminal that utilizes radio waveform shall meet the Regulation #3 of the 21st Article in the Regulations for Enforcement of the Radio Law and the Regulation #2 of the 14th Article in the Ordinance Regulating Radio Equipment.

3.1.2.9 Mobile Identification Number

It is desired that assignment of a mobile identification number and grant for protocol negotiation are determined with consideration of users' sufficient convenience such as flexible network selection, roaming availability, information security measure, radio Access Network policy, etc.

3.1.2.10 Malfunctioning Access Terminal to abort radio transmission

The system shall be able to apply the following measures independently:

a) As the Access Network detects malfunction of an Access Terminal, it shall be able to enforce the Access Terminal to abort transmitting radio signals.

b) As the Access Terminal detects its malfunction, it shall abort transmitting radio signals upon expiring of its malfunction detection timer.

3.1.2.11 Transmitter requirements

3.1.2.11.1 Frequency stability (ORE, Article 5, Table 1, No. 31, (19))

AT: Less than or equal to ±2.5 ppm

AN: Less than or equal to ±0.05 ppm

3.1.2.11.2 Occupied bandwidth (ORE Article 6, Table 2, No.51, 2)

5 MHz BW system: Less than or equal to 4.9 MHz

10 MHz BW system: Less than or equal to 9.5 MHz

3.1.2.11.3 Transmit power (ORE, Article 49.28)

AT: Less than or equal to 200 mW (23 dBm)

AN: Less than or equal to 20 W (43 dBm)

3.1.2.11.4 Transmit power tolerance (ORE, Article 14)

AT: Not less than -58 % and not greater than +48 %

AN: Not less than -47 % and not greater than +87 %

3.1.2.11.5 Adjacent channel leakage power limitation (NT No.651, 2007)

5 MHz System

a) AT

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
5 MHz ± 2.45 MHz,	Not exceed the level of -33 dB lower to the transmit power or -10 dBm
Equal or greater than 7.5 MHz and not exceed 10 MHz	Not exceed the level of: -3 - 3.2 x |Δf| dBm/MHz
Equal or greater than 10 MHz and not exceed 12.5 MHz	Not exceed the level of: -21 - 1.4 x |Δf| dBm/MHz

b) AN

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
5 MHz ± 2.45 MHz,	Not exceed the level of -45 dB lower to the transmit power or -2 dBm
Equal or greater than 7.5 MHz and not exceed 10 MHz	Not exceed the level of: -7 - 4 x |Δf| dBm/MHz
Equal or greater than 10 MHz and not exceed 12.5 MHz	Not exceed the level of: -27 - 2 x|Δf| dBm/MHz

10MHz System

a) AT

Offset Frequency (MHz)	Emission Limit

(Offset from the center frequency)	(Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
10 MHz ± 4.75 MHz,	Not exceed the level of -33 dB lower to the transmit power or -10 dBm
Equal or greater than 15 MHz and not exceed 20 MHz	Not exceed the level of: -3 - 1.6 x |Δf| dBm/MHz
Equal or greater than 20 MHz and not exceed 25 MHz	Not exceed the level of: -21 - 0.7 x |Δf| dBm/MHz

b) AN

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
10 MHz ± 4.75 MHz,	Not exceed the level of -45 dB lower to the transmit power or -2 dBm
Equal or greater than 15 MHz and not exceed 20 MHz	Not exceed the level of: -7 - 2 x |Δf| dBm/MHz
Equal or greater than 20 MHz and not exceed 25 MHz	Not exceed the level of: -27 - |Δf| dBm/MHz

3.1.2.11.6 Unwanted emission limitation on spurious band (NT No.651, 2007)

a) AT

Frequency	Emission Limit
9 kHz or greater and less than 150 kHz,	Not exceed -36 dBm/kHz
150 kHz or greater and less than 30 MHz	Not exceed -36 dBm/10kHz
30 MHz or greater and less than 1000 MHz	Not exceed -36 dBm/100kHz
1000MHz or greater and less than 2505 MHz	Not exceed -30 dBm/MHz
2505 MHz or greater and less than 2520 MHz	Not exceed -42 dBm/MHz
2520 MHz or greater and less than 2530 MHz	Not exceed -42 + 0.75 x (f-2520) dBm/MHz, where f is the frequency (MHz) used by the transmitter and is in the frequency band shown the left column.

2530 MHz or greater and less than 2535 MHz	Not exceed -34.5 + 1.5 x (f-2530) dBm/MHz, where f is the frequency (MHz) used by the transmitter and is in the frequency band shown the left column.
2535 MHz or greater and less than 2630 MHz See [Note] following the table.	Not exceed -30 dBm/MHz
2630 MHz or greater and less than 2635 MHz	Not exceed -22 - (f - 2630) dBm/MHz, where f is the frequency (MHz) used by the transmitter and is in the frequency band shown the left column.
2635 MHz or greater and less than 2640 MHz	Not exceed -27 - 3/2 x (f - 2635) dBm/MHz, where f is the frequency (MHz) used by the transmitter and is in the frequency band shown the left column.
2640 MHz or greater and less than 2650 MHz	Not exceed -34.5 - 3/4 x (f - 2640) dBm/MHz, where f is the frequency (MHz) used by the transmitter and is in the frequency band shown the left column.
2650 MHz or greater and less than 2655 MHz	Not exceed -42 dBm/MHz
2655 MHz or greater	Not exceed -30 dBm/MHz

[Note] For 5 MHz systems, the emission limits above are applied to the band where offset frequency is 12.5 MHz or greater. For 10 MHz systems, the emission limits above are applied to the band where offset frequency is 25 MHz or greater.

b) AN

Frequency	Emission Limit

9 kHz or greater and less than 150 kHz,	Not exceed -13 dBm/kHz
150 kHz or greater and less than 30 MHz	Not exceed -13 dBm/10kHz
30 MHz or greater and less than 1000 MHz	Not exceed -13 dBm/100kHz
1000MHz or greater and less than 2505 MHz	Not exceed -13 dBm/MHz
2505 MHz or greater and less than 2535 MHz	Not exceed -44 dBm/MHz
2535 MHz or greater and less than 2630 MHz See [Note] following the table.	Not exceed -30 dBm/MHz
2630 MHz or greater and less than 2635 MHz	Not exceed -22 - 5/3 x (f - 2626) dBm/MHz, where f is the frequency (MHz) used by the transmitter and is in the frequency band shown the left column.
2635 MHz or greater and less than 2640 MHz	Not exceed -37 - 2 x (f - 2635) dBm/MHz, where f is the frequency (MHz) used by the transmitter and is in the frequency band shown the left column.
2640 MHz or greater and less than 2655 MHz	Not exceed -47 - (f - 2640) dBm/MHz, where f is the frequency (MHz) used by the transmitter and is in the frequency band shown the left column.
2655 MHz or greater	Not exceed -13 dBm/MHz

[Note] For 5 MHz systems, the emission limits above are applied to the band where offset frequency is 12.5 MHz or greater. For 10 MHz systems, the emission limit above are applied to the band where offset frequency is 25 MHz or greater.

3.1.2.11.7 Intermodulation characteristics at the transmitter of the Access Network (NT No.651, 2007)

5 MHz system

Under the condition that AN transmits desired signal at the operation signal strength, the intermodulation signal, generated by the interfering waveforms that have signal strength less than the operation signal level and that frequency offsets of ±5 MHz and ±10 MHz at transmitted at the signal strength of 30 dB less than the operation signal strength, shall not exceed the limits of adjacent channel leakage power.

10 MHz system

Under the condition that AN transmits desired signal at the operation signal strength, the intermodulation signal, generated by the interfering waveforms that have signal strength less than the operation signal level and that frequency offsets of ±10 MHz and ±20 MHz at transmitted at the signal strength of 3 dB (See [Note] below) less than the operation signal strength, shall not exceed the limits of adjacent channel leakage power.

[Note] Not 3 dB but 30 dB is correct. This is going to be revised and corrected in the ORE. See Chapter 5 for details.

3.1.2.11.8 Transmitted burst length tolerance (NT No.651, 2007)

Transmitted burst length tolerance at each sector shall not be greater than ±10 μs.

3.1.2.11.9 Maximum absolute antenna gain (ORE, Article 49.28)

AT: Not exceed 0 dB

AN: Not exceed 17 dBi

3.1.2.11.10 Residual emission limit when carrier output is off (ORE, Article 49.28)

AT: Not exceed -30 dBm

AN: Not exceed -30 dBm

3.1.2.11.11 Emission limit from terminal chassis

Less than 4 nW/MHz in EIRP or less than the unwanted emission strength in EIRP measured at the antenna connector that is multiplied by 0 dBi.

3.1.2.11.12 SAR (ORE, Article 14.2)

Specific absorption rate (SAR) at the head of human body measured with the emission of the AT shall not exceed 2 watts per kilogram or less. SAR is the rate of energy absorption in a 10 grams of body tissue during 6 minutes, which is derived by divisions by 10 grams and 6 minutes.

3.1.2.12 Receiver requirements

3.1.2.12.1 Receiver sensitivity

Receiver sensitivity is the minimum receiving signal strength to receive QPSK modulated signal at the specified quality (FER not exceeding 1 x 10^{-2}) measured at the antenna connector tap of the receiver. In static condition, the following receiver sensitivity requirements shall be met.

5MHz System

AT: Not exceed -104 dBm (FER not exceeding 1%, QPSK(r=1/2), Max. 6 HARQ re-transmission, all traffic subcarriers in use)

AN: Not exceed -108 dBm (FER not exceeding 1%, QPSK(r=1/2), Max. 6 HARQ re-transmission, all traffic subcarriers in use) [Note] For lower rate transmission, higher receiver sensitivity can be applied.

10MHz System

AT: Not exceed -101 dBm (FER not exceeding 1%, QPSK(r=1/2), Max. 6 HARQ re-transmission, all traffic subcarriers in use)

AN: Not exceed -105 dBm (FER not exceeding 1%, QPSK(r=1/2), Max. 6 HARQ re-transmission, all traffic subcarriers in use) [Note] For lower rate transmission, higher receiver sensitivity can be applied.

3.1.2.12.2 Spurious response

Spurious response is a receiver capability measure to receive signal successfully in the presence of a continuous (non-modulated) interference radio wave. Under the condition that wanted signal is interfered by a non-modulated radio wave, FER shall not exceed 1x 10^{-2} when the receiver receives the wanted signal transmitted at the specified bit rate (FL: all traffic subcarriers in use, C/I = -5 dB; RL: all traffic subcarriers in use, C/I = -5 dB) .

Requirements in static condition are as follows.

AT: Wanted signal power level is 3 dB greater than the reference sensitivity signal level. Continuous (non-modulated) waveform power level is -44 dBm.

AN: Wanted signal power level is 3 dB greater than the reference sensitivity signal level. Continuous (non-modulated) waveform power level is -44 dBm.

3.1.2.12.3 Adjacent channel selectivity

Adjacent channel selectivity is a receiver capability measure in presence of a modulated radio wave as interference in the adjacent channel. Under the condition that wanted signal is interfered by a modulated radio wave in the adjacent channel, FER shall not exceed 1x 10^{-2}, when the receiver receives the wanted signal transmitted at the specified modulation and coding rate.

Requirements in static condition are as follows:

AT: Wanted signal level is 14 dB greater than the reference sensitivity signal level. Continuous waveform power level is -52 dBm.

AN: Wanted signal level is 14 dB greater than the reference sensitivity signal level. Continuous waveform power level is -52 dBm. FL input signal is QPSK, r=1/2 (all subcarriers in use), C/I = -5 dB. UL input signal = QPSK, r=1/2 (all subcarriers in use), C/I = -5 dB.

3.1.2.12.4 Intermodulation selectivity

This is a receiver capability measure to receive the wanted signal in presence of two continuous (non-modulated) radio waves that are in the 3rd order intermodulation relationship. One of them may be a modulated radio wave as interference waveform. Under the condition that wanted signal is interfered by non-modulated and modulated radio waves that are in 3rd order intermodulation, FER shall not exceed 1x 10^{-2} when the receiver receives the wanted signal transmitted at the specified bit rate (FL: QPSK, all traffic subcarriers in use, C/I = -5 dB; UL: QPSK, all traffic subcarriers in use, C/I = -5 dB).

Requirements in static condition are as follows.

AT:

Wanted signal level is 3 dB greater than the reference sensitivity signal level.

Continuous waveform power level (adjacent channel) is -46dBm.

Modulated waveform power level (2nd adjacent channel) is -46dBm.

AN:

Wanted signal level is 3 dB greater than the reference sensitivity signal level.

Continuous waveform power level (adjacent channel) is -48dBm

Modulated waveform power level (2nd adjacent channel) is -48dBm

3.1.2.12.5 Conducted emission limit from the receiver in the AT (ORE, Article 24, No.13)

Frequency	Emission limit
Less than 1GHz:	Not exceed 4 nW
Equal or greater than 1 GHz:	Not exceed 20 nW

3.2 625k-MC Mode

3.2.1 Radio Equipment

The following is assumed for the radio equipment:

UT (User Terminal)

BS (Base Station)

3.2.2 General Requirements

3.2.2.1 Duplex method (ORE, Article 49.30)

TDD (Time Division Duplex)

3.2.2.2 Frequency band (ORE, Article 49.30)

2545 MHz - 2575 MHz, 2595 MHz - 2625 MHz

3.2.2.3 Multiplexing method (ORE, Article 49.30)

Reverse Link (The radio connection with the UT transmitting and the BS receiving)

Multiple method of FDMA (Frequency Division Multiple Access), TDMA (Time Division Multiple Access) and SDMA (Spatial Division Multiple Access)

Forward Link (The radio connection with the BS transmitting and the UT receiving)

Multiple method of FDM (Frequency Division Multiplex), TDM (Time Division Multiplex) and SDM (Space Division Multiplex)

3.2.2.4 Modulation (ORE, Article 49.30)

Reverse Link

BPSK, QPSK, 8PSK, 12QAM, 16QAM, 24QAM, 32QAM, 64QAM

Modulation Class	Modulation Method
Mod 0	BPSK
Mod 1	BPSK+
Mod 2	QPSK
Mod 3	QPSK+
Mod 4	8PSK
Mod 5	8PSK+
Mod 6	12QAM
Mod 7	16QAM
Mod 8	24QAM
Mod 9	32QAM
Mod 10	64QAM

[Note] "+" means a change of coding rate

Forward Link

BPSK, QPSK, 8PSK, 12QAM, 16QAM, 24QAM, 32QAM, 64QAM

Modulation Class	Modulation Method
Mod 0	BPSK
Mod 1	BPSK+
Mod 2	QPSK
Mod 3	QPSK+
Mod 4	8PSK
Mod 5	8PSK+
Mod 6	12QAM
Mod 7	16QAM
Mod 8	24QAM
Mod 9	32QAM
Mod 10	64QAM

[Note] "+" means a change of coding rate

3.2.2.5 Transmission timing and synchronization

(1) FL:RL time-partitioning ratio

2:1

(2) Transmitted burst length (NT, No.651, 2007)

Reverse Link: 1.635ms

Forward Link: 3.270ms

(3) Transmitted burst repetition period

Frame length is 5ms. Both uplink and down link portions of each frame is divided into three time slots.

(4) Synchronization requirement between sectors

Frame synchronization accuracy: ±2μsec

3.2.2.6 Authentication, encryption, information security measure

Same as the Wideband mode requirement. See section 3.1.2.6.

3.2.2.7 Electro-Magnetic Compatibility and Protection

Same as the Wideband mode requirement. See section 3.1.2.7.

3.2.2.8 Compliance to the radio protection policy

The user terminals that utilize radio waveform shall meet the Regulation #3 of the 21st Article in the Regulations for Enforcement of the Radio Law and the Regulation #2 of the 14th Article in the Ordinance Regulating Radio Equipment.

3.2.2.9 Mobile Identification Number

Same as the Wideband mode requirement. See section 3.1.2.9.

3.2.2.10 Malfunctioning user terminal to abort radio transmission

Same as the Wideband mode requirement. See section 3.1.2.10.

3.2.2.11 Transmitter requirements

3.2.2.11.1 Frequency stability (ORE, Article 5, Table 1 #31, (21))

UT: Less than or equal to ±10kHz to a base station

(at the time of Broadcast Channel reception)

Less than or equal to ±100Hz to a base station

(after the time of Broadcast channel reception)

BS: Less than or equal to ±0.05 ppm

3.2.2.11.2 Occupied bandwidth (ORE, Article 6, Table 2 #53)

5 MHz BW system: 99% bandwidth is below 600kHz / carrier

10 MHz BW system: 99% bandwidth is below 600kHz / carrier

3.2.2.11.3 Transmit power (ORE, Article 49.30)

UT:

Below 158mW (22dBm) (Type A:Power Class 3 terminal)

Below 500mW (27dBm) (Type B:Power class 2 terminal)

BS:

The following values are total power of the transmit antennas

5MHz System: below 19W (42.8dBm)

10MHz System: below 38W (45.8dBm)

3.2.2.11.4 Transmit power tolerance (ORE, Article 14)

UT: Not less than -50% and not greater than +50%

BS: Not less than -50% and not greater than +50%

3.2.2.11.5 Adjacent channel leakage power limitation (NT No.651, 2007)

5 MHz System

a) UT

i) Transmit power is equal or less than 0.16W

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
Equal or greater than 2.8125 MHz and not exceed 3.4375 MHz	Not exceed the level of -13 dBm /500kHz
Equal or greater than 3.4375 MHz and not exceed 4.0625 MHz	Not exceed the level of -23 dBm /500kHz
Equal or greater than 4.0625 MHz and not exceed 7.5 MHz	Not exceed the level of -28 dBm /500kHz
Equal or greater than 7.5 MHz and not exceed 12.5 MHz	Not exceed the level of -30 dBm /MHz

ii) Transmit power is greater than 0.16W and equal or less than 0.5W

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
Equal or greater than 2.8125 MHz and not exceed 3.4375 MHz	Not exceed the level of -8 dBm /500kHz
Equal or greater than 3.4375 MHz and not exceed 4.0625 MHz	Not exceed the level of -18 dBm /500kHz

Equal or greater than 4.0625 MHz and not exceed 7.5 MHz	Not exceed the level of -23 dBm /500kHz
Equal or greater than 7.5 MHz and not exceed 12.5 MHz	Not exceed the level of -30 dBm /MHz

b) BS

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
Equal or greater than 2.8125 MHz and not exceed 3.4375 MHz	Not exceed the level of -9.2 dBm /500kHz
Equal or greater than 3.4375 MHz and not exceed 7.5 MHz	Not exceed the level of -16.2 dBm /500kHz
Equal or greater than 7.5 MHz and not exceed 12.5 MHz	Not exceed the level of -30 dBm /MHz

10MHz System

a) UT

i) Transmit power is equal or less than 0.16W

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
Equal or greater than 5.3125 MHz and not exceed 5.9375 MHz	Not exceed the level of -13 dBm /500kHz
Equal or greater than 5.9375 MHz and not exceed 6.5625 MHz	Not exceed the level of -23 dBm /500kHz
Equal or greater than 6.5625 MHz and not exceed 10 MHz	Not exceed the level of -28 dBm /500kHz
Equal or greater than 10 MHz and not exceed 25 MHz	Not exceed the level of -30 dBm /MHz

ii) Transmit power is greater than 0.16W and equal or less than 0.5W

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)

Equal or greater than 5.3125 MHz and not exceed 5.9375 MHz	Not exceed the level of -8 dBm /500kHz
Equal or greater than 5.9375 MHz and not exceed 6.5625 MHz	Not exceed the level of -18 dBm /500kHz
Equal or greater than 6.5625 MHz and not exceed 10 MHz	Not exceed the level of -23 dBm /500kHz
Equal or greater than 10 MHz and not exceed 25 MHz	Not exceed the level of -30 dBm /MHz

b) BS

Offset Frequency (MHz) (Offset from the center frequency)	Emission Limit (Δf (MHz) below is offset frequency from the nearest edge of the channel bandwidth)
Equal or greater than 5.3125 MHz and not exceed 5.9375 MHz	Not exceed the level of -9.2 dBm /500kHz
Equal or greater than 5.9375 MHz and not exceed 10 MHz	Not exceed the level of -16.2 dBm /500kHz
Equal or greater than 10 MHz and not exceed 25 MHz	Not exceed the level of -30 dBm /MHz

3.2.2.11.6 Unwanted emission limitation in spurious band) (NT No.651, 2007)

a) UT

Frequency	Emission Limit
9 kHz or greater and less than 150 kHz,	Not exceed - 13dBm/kHz
150 kHz or greater and less than 30 MHz	Not exceed - 13dBm/10kHz
30 MHz or greater and less than 1000 MHz	Not exceed - 13dBm/100kHz
1000MHz or greater and less than 2505 MHz	Not exceed - 13dBm/MHz
2505 MHz or greater and less than 2535 MHz	Not exceed - 42dBm/MHz
2535 MHz or greater and less than 2630 MHz See [Note] following the table.	Not exceed - 30dBm/MHz
2630 MHz or greater and less than 2655 MHz	Not exceed - 30dBm/MHz
2655 MHz or greater	Not exceed - 13dBm/MHz

[Note] For 5 MHz systems, the emission limits above are applied to the band where offset frequency is 12.5 MHz or greater. For 10 MHz systems, the emission limit above are applied to the band where offset frequency is 25 MHz or greater.

b) BS

Frequency	Emission Limit
9 kHz or greater and less than 150 kHz,	Not exceed - 13dBm/kHz
150 kHz or greater and less than 30 MHz	Not exceed - 13dBm/10kHz
30 MHz or greater and less than 1000 MHz	Not exceed - 13dBm/100kHz
1000MHz or greater and less than 2505 MHz	Not exceed - 13dBm/MHz
2505 MHz or greater and less than 2535 MHz	Not exceed - 40dBm/MHz
2535 MHz or greater and less than 2630 MHz See [Note] following the table.	Not exceed - 13dBm/MHz
2630 MHz or greater	Not exceed - 13dBm/MHz

[Note] For 5 MHz systems, the emission limits above are applied to the band where offset frequency is 12.5 MHz or greater. For 10 MHz systems, the emission limit above are applied to the band where offset frequency is 25 MHz or greater.

3.2.2.11.7 Unwanted intermodulation characteristics at the transmitter of the Base station (NT No.651, 2007)

Unwanted intermodulation characteristics at the transmitter of the Base station is equal or less than a value described in 3.2.2.11.5 Adjacent channel leakage power limitation

[Note] This description in the ORE is going to be revised See section 3.1.11.7. See Chapter 5 for details.

3.2.2.11.8 Transmitted burst length tolerance (NT No.651, 2007)

Transmitted burst length at each sector shall not be greater than the following.

Reverse Link: ±2μs

Forward Link: ±4μs

[Note] Above is applicable in STD-T97 Ver. 1.0, based on the current NT. The burst lengths are going to be updated and corrected in the ORE. See Chapter 5 for detail.

3.2.2.11.9 Maximum absolute antenna gain allowed (ORE, Article 49.30)

UT: Below 4dBi

BS: Below 11dBi

3.2.2.11.10 Residual emission limit when carrier output is off (ORE, Article 49.28)

UT: Not exceed -60 dBm/MHz

BS: Not exceed -60 dBm/MHz

3.2.2.11.11 SAR (ORE, Article 14.2)

Specific absorption rate (SAR) at the head of human body measured with the emission of the UT shall not exceed 2 watts per kilogram or less. SAR is the rate of energy absorption in a 10 grams of body tissue during 6 minutes, which is derived by divisions by 10 grams and 6 minutes.

3.2.2.12 Receiver requirements

3.2.2.12.1 Receiver sensitivity

Receiver sensitivity is the minimum receiving signal strength to receive QPSK modulated signal at the specified quality (FER not exceeding 1%) measured at the antenna connector tap of the receiver. In static condition, the following receiver sensitivity requirement shall be met.

Receiver sensitivity that maintains FER not exceeding 1% in a static characteristic satisfies a receiving sensitivity standard shown below.

Receiving standard sensitivity of a User Terminal and a Base Station

Modulation Class	User Terminal Standard[dBm]	Base Station Standard[dBm]
Mod 0	-108.6	-107.5
Mod 1	-107.0	-105.7
Mod 2	-105.3	-104.2
Mod 3	-102.4	-101.3
Mod 4	-100.2	-100.1
Mod 5	-97.9	-96.9
Mod 6	-95.9	-94.8
Mod 7	-94.6	-93.5
Mod 8	-92.6	-91.6
Mod 9	-90.6	-89.2
Mod 10	-86.0	-86.2

3.2.2.12.2 Spurious response

Requirements in static condition are as follows.

UT:

Equal to or greater than -40dBm.

BS:

In band	: Equal to or greater than 46dB
0Hz $< f_{off} \leq$ 1MHz	: Equal to or greater than 46dB
1MHz $< f_{off} \leq$ 15MHz	: Equal to or greater than 46dB
15MHz $< f_{off}$	: Equal to or greater than 56dB

3.2.2.12.3 Adjacent channel selectivity

Adjacent channel selectivity is a measure of the ability to receive a desired signal with the presence of undesired modulated signal in adjacent band. FER measured shall not exceed $1x10^{-2}$ when the desired signal is transmitted at 3 dB higher Tx level than the reference level with the presence of undesired modulated signal in adjacent band as specified below

Static characteristic	Modulation class	Undesired modulated signal level
UT:	0 - 6	20dB
	7 - 8	17dB
	9 - 10	11dB
BS:	0 - 10	30dB

[Note] Although the other adjacent channel selectivity are specified in [3], above is applicable in STD-T97 Ver. 1.0. See Chapter 5 for detail.

3.2.2.12.4 Intermediation selectivity

This is a receiver capability measure to receive the desired signal in presence of two continuous (non-modulated) radio waves that are in 3rd order intermodulation relationship. Under the following condition that desired signal is interfered by two non-modulated radio waves that are in 3rd order intermodulation, FER shall not exceed $1x\ 10^{-2}$ while the desired signal transmitted in Mod8 24QAM. Requirements in static condition are as follows.

Static characteristic

UT:

In band

Desired wave power level: Standard sensitivity +3dB

Undesired non modulated wave power level l(adjacent channel): Desired wave +17dB

Undesired non modulated wave power level (Next adjacent channel): Desired wave +17dB

BS:

In band

Desired wave power level: Standard sensitivity +3dB

Undesired non modulated wave power level (adjacent channel): Desired wave +30dB

Undesired non modulated wave power level (Next adjacent channel): Desired wave +30dB

Out band

When offset frequency from the end of an assigned frequency zone is set to f_{off}, the undesired wave input level to the desired wave is specified as follows.

$0Hz < f_{off} \leq 2MHz$	: 30dB
$2MHz \leq f_{off} \leq 15MHz$	: 41dB
$15MHz < f_{off}$	: 45dB

3.2.2.12.5 Conducted emission limit from the receiver in the UT (ORE Article 24, No.13)

Frequency	Emission limit
Less than 1GHz:	not exceed 4 nW
Equal or greater than 1 GHz:	not exceed 20 nW

Chapter 4 Physical and Media Access Control Layer Specification

This chapter provides subheadings to detailed physical layer and media access control layer specifications of the MBWA systems. The Wideband mode in [3] is designed for Frequency Division Duplex (FDD) and Time Division Duplex (TDD) operations. The Wideband mode specification is described in section 4.1, and 4.2 through 4.13. The FDD specification is not scope of this standard.

The 625k-MC mode is designed with 625 kHz carrier bandwidth supporting aggregation of multiple carriers for TDD operation only. The 625k-MC mode specification is described in section 4.1 and 4.14 through 4.28.

4.1 Overview

Refer to “Chapter 5 General Introduction” of [3].

General overview of this specification, Wideband mode overview, and 625k-MC mode overview are described.

4.2 Wideband Mode Service Sublayer

Refer to “Chapter 6 Service Sublayer” of [3].

This chapter specifies Wideband mode Service Sublayer that consists of Basic Signaling Protocol, Basic Inter-Route Tunneling Protocol, Basic ROHC Support Protocol, and Basic EAP Support Protocol.

4.3 Wideband Mode Radio Link Sublayer

Refer to “Chapter 7 Radio Link Sublayer” of [3].

This chapter specifies Wideband mode Radio Link Sublayer that provides the following functions:

- Negotiation of packet filters and Quality of Service (QoS) for IP packets
- Mapping of Reservations to Streams
- Segmentation, reassembly, retransmission and duplicate detection of higher Sublayer packets
- Multiplexing of application streams
- Determination of Route Protocol packets for transmission

4.4 Wideband Mode Lower MAC Sublayer

Refer to “Chapter 8 Lower MAC Sublayer” of [3].

This chapter specifies Wideband mode Lower MAC Sublayer that consists of Basic Packet Consolidation Protocol, Basic Superframe Preamble MAC Protocol, Basic Access Channel MAC Protocol, Basic Forward Link Control Segment MAC Protocol, Basic Forward Traffic Channel MAC Protocol, Basic Reverse Control Channel MAC Protocol, and Basic Reverse Traffic Channel MAC Protocol.

4.5 Wideband Mode Physical Layer

Refer to “Chapter 9 Physical Layer” of [3].

This chapter describes Wideband mode Physical Layer specification including timing management, frame and superframe structure, coding and modulation, OFDMA numerologies, frequency hopping, MIMO and SDMA procedures, Forward Link subcarrier allocation, Reverse Link subcarrier allocation, traffic and control channel schemes, Access Terminal requirements, Access Network requirement, and BCMCS operation.

Some Physical Layer restrictions for Japan 2.5 GHz band application are shown in section 3.1.2.5 in this standard.

4.6 Wideband Mode Security Functions

Refer to “Chapter 10 Security Functions” of [3].

This chapter describes Security Function specification that consists of AES Ciphering Protocol, Basic Message Integrity Protocol, and Basic Key Exchange Protocol.

4.7 Wideband Mode Connection Control Sublayer

Refer to “Chapter 11 Connection Control Sublayer” of [3].

This chapter specifies Wideband mode Connection Control Sublayer that consists of Basic Air Link Management Protocol, Basic Initialization State Protocol, Basic Idle State Protocol, Basic Connected State Protocol, Overhead Messages Protocol, Basic Active Set Management Protocol, Protocol Numeric Constants, and Session State Information.

4.8 Wideband Mode Session Control Plane

Refer to “Chapter 12 Session Control Plane” of [3].

This chapter specifies Wideband mode Session Control Plane that includes Basic Session Control Protocol, negotiation procedure of unicast address (UATI) and Paging Identifier (PagingID) assigned to the Access Terminal, the set of protocols used by the Access Terminal and the Access Network to communicate over the air-link, and configuration settings for these protocols.

4.9 Wideband Mode Route Control Plane

Refer to "Chapter 13 Route Control Plane" of [3].

This chapter specifies Wideband mode Route Control Protocol that controls and maintains Route.

4.10 Wideband Mode Broadcast Support

Refer to "Chapter 14 Broadcast Support" of [3].

This chapter specifies Wideband mode Broadcast-Multicast Upper Layer.

4.11 Wideband Mode Common Procedures and Data Structures

Refer to "Chapter 15 Common Procedures and Data Structures" of [3].

This chapter specifies procedures and data structures commonly used in the Wideband mode.

4.12 Wideband Mode Assigned Names and Numbers

Refer to "Chapter 16 Assigned Names and Numbers" in [3]

This chapter specified Assigned Names and Numbers including protocol types, subtypes, protocol IDs, procedures of ANID, SectorID, and UATI provisioning.

4.13 Wideband Mode MAC and PHY MIB

Refer to "Chapter 17 MAC and PHY MIB" in [3].

This chapter describe Wideband mode MAC and PHY MIB.

4.14 625k-MC Spectral Layout Terminology and Requirements

Refer to "Chapter 18 625k-MC Spectral Layout Terminology and Requirements" in [3]

This chapter describes 625k-MC Spectral Layout Terminology and Requirements.

4.15 625k-MC Slot and Frame Structure

Refer to "Chapter 19 625k-MC Slot and Frame Structure" in [3].

This chapter describes 625k-MC Slot and Frame Structure. 625k-MC is a TDD system with 625 kHz allocated to each RF channel. Each RF channel consists of three uplink/downlink time-slot pairs, which together form a frame.

4.16 625k-MC Modulation and Channel Coding

Refer to "Chapter 20 625k-MC Modulation and Channel Coding" in [3].

This chapter specifies 625k-MC Modulation and Channel Coding. The standard uplink and downlink bursts employ coding and modulation schemes to provide different data rates. Primarily, a rate-1/2 convolutional encoder provides channel coding. Some of the coding schemes employ puncturing for increased data rates. In addition, some coding schemes employ block coding in addition to convolutional coding.

4.17 625k-MC User Terminal Radio Transmission and Reception

Refer to "Chapter 21 625k-MC User Terminal Radio Transmission and Reception" in [3].

This chapter describes 625k-MC User Terminal Radio Transmission and Reception that includes the radio frequency performance characteristics of 625k-MC user terminal.

4.18 625k-MC Base Station Radio Transmission and Reception

Refer to "Chapter 22 625k-MC Base Station Radio Transmission and Reception" in [3].

This chapter describes 625k-MC Base Station Radio Transmission and Reception that includes the radio frequency performance characteristics of 625k-MC Base Station.

4.19 625k-MC L2 MAC Protocol Sublayer Specification

Refer to "Chapter 23 625k-MC L2 MAC Protocol Sublayer Specification" in [3].

This chapter specifies 625k-MC L2 MAC Protocol Sublayer Specification that consists of Access management and control functions between UT and BS, Mapping of logical to physical channels, Transfer services for control and traffic data by way of logical channels.

4.20 625k-MC L2 RLC Protocol Sublayer Specification

Refer to "Chapter 24 625k-MC L2 RLC Protocol Sublayer Specification" in [3].

This chapter describes 625k-MC L2 RLC Protocol Sublayer Specification.

4.21 625k-MC L3 Protocol Specification

Refer to "Chapter 25 625k-MC L3 Protocol Specification" in [3].

This chapter describes 625k-MC L3 Protocol Specification that the protocol layer responsible for presenting and managing a logical connection between UT and BS across the air interface.

4.22 625k-MC Protocol Layer Primitives (Informative)

Refer to "Chapter 26 625k-MC Protocol Layer Primitives (Informative)" in [3].

This chapter lists the primitives used by the 625k-MC protocol layers to interact with each other.

4.23 625k-MC QoS Enhancements

Refer to "Chapter 27 625k-MC QoS Enhancements" in [3].

This chapter specifies 625k-MC QoS Enhancements.

4.24 625k-MC Broadcast and Multicast Service (BCMCS) Support Enhancement

Refer to "Chapter 28 625k-MC Broadcast and Multicast Service (BCMCS) Support Enhancement" in [3].

This chapter specifies 625k-MC Broadcast and Multicast Service (BCMCS) Support Enhancement.

4.25 625k-MC Privacy and Authentication Enhancement

Refer to "Chapter 29 625k-MC Privacy and Authentication Enhancement" in [3].

This chapter describes 625k-MC Privacy and Authentication Enhancement, more specifically, Handshake and Authentication Protocol (i-HAP), Secure Communication Protocol (i-SEC), and Terminal Authentication Protocol (i-TAP).

4.26 625k-MC Sleep Mode Control Protocol

Refer to "Chapter 30 625k-MC Sleep Mode Control Protocol" in [3].

This chapter describes 625k-MC Sleep Mode Control Protocol about a power down mode on UT side.

4.27 625k-MC OA & M Radio Network Quality Monitor and Control Enhancement

Refer to "Chapter 31 625k-MC OA & M Radio Network Quality Monitor and Control Enhancement" in [3].

This chapter describes about 625k-MC OA & M Radio Network Quality Monitor and Control Enhancement, and defines Management Information Base (MIB) module for managing the 625k-MC mode.

4.28 625K-MC Glossary of Technical Terms - Annex – A (Informative)

Refer to "Annex-A " 625k-MC Glossary of Technical Terms (Informative)" in [3].

Chapter 5 Specific Notes to the ARIB STD-T97 Version 1.0

The following table lists the specifications that ARIB STD-T97 Version 1.0 is not compliant to IEEE 802.20™ "The Standard for Local and Metropolitan Area Networks – Standard Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility – Physical and Media Access Control Layer Specification" [3]. Most issues were noted because the requirements for this standard in the Japan ORE [1] and [2] were regulated in accordance with specifications in a draft version of [3]. Those are going to be revised as a revision is made in the Japan ORE in future. An issue (No.8) may need minor revision in [3].

Table 5-1 Specific Notes to the ARIB STD-T97 Version 1.0

No.	Issues	Specific Notes	Remarks	Sections concerned
1	Duplex method	ARIB STD-T97 Version 1.0 does not allow the Wideband mode FDD operation specified in [3]	The ORE does not allow FDD operation in the band specified in Section 3.1.2.2	3.1.2.1 Duplex method 3.1.2.2 Frequency band 4.5 Wideband Mode Physical Layer
2	Channel bandwidth	ARIB STD-T97 Version 1.0 does not allow operation with channel bandwidth greater than 10 MHz specified in [3]	As of the issued date of ARIB STD-T97 Version 1, the ORE does not regulate requirements for the system with channel bandwidth more than 10 MHz.	3.1.2.11.2 Occupied bandwidth, 3.1.2.11.5 Adjacent channel leakage power limitation, 3.1.2.11.6 Transmit emission mask, 3.1.2.11.7 Intermodulation characteristics, 3.1.2.12.1 Receiver sensitivity 3.2.2.11.2 Occupied bandwidth, 3.2.2.11.5 Adjacent channel leakage

				power limitation, 3.2.2.11.6 Transmit emission mask, 3.2.2.11.7 Intermodulation characteristics, 3.2.2.12.1 Receiver sensitivity 4.5 Wideband Mode Physical Layer
3	DL-UL time-partitioning ratio (Wideband mode)	For the Wideband mode, ARIB STD-T97 Version 1.0 allows only DL-UL time-partitioning ratios in frames only of 4:4 and 6:3 in [3] while the ORE allows M:N.	The ORE regulation refers to the Wideband mode specification in the 1st draft of [3]. The ORE is going to be revised in future to resolve inconsistencies	3.1.2.5 (1) Transmission timing and synchronization 4.5 Wideband Mode Physical Layer
4	Transmitted burst length and its repetition period (Wideband mode)	This concerns the Wideband mode, ARIB STD-T97 Version 1.0 allows the preamble length of 1070 μs while [3] specifies those of 911.44 μs, 963.52 μs, 1,015.60 μs, and 1,067.68 μs, depending on cyclic prefix duration. Also, ARIB STD-T97 Version 1.0 allows the PHY frame length of 911.46 μs while [3] specifies those of 911.44 μs, 963.52 μs, 1,015.60 μs, and 1,067.68	The ORE regulation refers to the Wideband mode specification in the 1st draft of [3]. The ORE is going to be revised in future to resolve inconsistencies.	3.1.2.5(2) Transmission burst length, 3.1.2.5(3) Transmission burst repetition period, and 4.5 Wideband Mode Physical Layer,

		µs, depending on cyclic prefix duration. Accordingly, transmission burst length and transmitted burst repetition period are not consistent to those in [3].		
5	Intermodulation characteristics (Wideband mode, 10 MHz system)	Signal strength of the interfering waveforms is 30 dB less than the operation signal strength, not 3 dB less than that.	The ORE is going to be revised in future to resolve inconsistency.	3.1.2.11.7 Intermodulation characteristics at the transmitter of the AN (10 MHz system)
6	Transmitted burst length tolerance (625k-MC mode)	ARIB STD-T97 Version 1.0 does not match to the 625k-MC mode specification in [3].	The ORE is going to be revised in future as follows: Reverse Link: 1.635ms ±4µs Forward Link: 3.270ms ±2µs	3.2.2.11.8 Transmitted burst length tolerance
7	Intermodulation characteristics (625k-MC mode)	This description is not clear in the ORE. This is going to be revised as same as the Wideband mode requirement of section 3.1.11.7	The ORE is going to be revised in future to resolve inconsistency.	3.2.2.11.8 Intermodulation characteristics at the transmitter of the BS
8	Adjacent channel selectivity (625k-MC mode)	This description is not same as in [3] at present.	The description of [3] is going to be updated as same as this description	3.2.2.12.3 Adjacent channel selectivity

Chapter 6 Measurement Method

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 (See Note below) 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 at September, 2008). 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 (IPRs) (Selection of Option 1)

Attachment 2 List of Essential Industrial Property Rights (IPRs)

(Selection of option 2)

特許出願人 PATENT HOLDER	発明の名称 NAME OF PATENT	出願番号等 REGISTRATION NO./ APPLICATION NO.	備考 （出願国名） REMARKS
Qualcomm Inc.*10	A comprehensive confirmation form has been submitted with regard to ARIB STD-T97 Ver.1.0		

*10: These patents are applied to the part defined by ARIB STD-T97 Ver.1.0.

Amendment History

Mobile Broadband Wireless Access Systems

(IEEE 802.20™ TDD Wideband and 625k-MC Modes Application in Japan)

ARIB STANDARD

(ARIB STD-T97)

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