IEEE P802.11
Wireless Access Methods and Physical Layer Specifications

English Translation & Preliminary Analysis of "RCR STD-33A", an Official Report on the Japanese Radio Laws Pertaining to 802.11

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ABSTRACT

After a brief background statement, translation of the Japanese regulations is given in outline form. Finally, a brief interpretation and analysis is presented, with the purpose of estimating similarities to equipment designed to operate under USA or European regulations.

BACKGROUND

In order to permit world-wide applicability of the P802.11 Standard and consequent world-wide markets for equipment manufactured thereunder, it is necessary to include minor variations of its provisions in order to accommodate differences in governmental RF regulations. For almost a year now, it has been the Committee's intention to include the necessary provisions for operation in Japan, in its microwave band going from 2471 MHz to 2497 MHz. To that end, a special PHY Frequency Hopping table using center frequencies from 2473 MHz to 2495 MHz, and a special Direct Sequence center frequency at 2484 MHz was included in the initial Draft Standard.

At the last P802.11 Session (May '95, Salt Lake City), the Committee attempted to write the remaining special provisions covering the remaining Japanese technical requirements but discovered that key statements in the existing English translation of the Japanese laws appeared ambiguous. Moreover, the Committee was unable to obtain a better translation before the end of the session. During the last month, ADVANCED MICRO DEVICES JAPAN obtained the following translation, which is believed (but not guaranteed) to be accurate. It should also be noticed that, unlike the previous one, this translation was performed on the latest revision of RCR.

The translation shown is as received by the Author, except as follows:

1. The outline was reformatted to be uniform and easily readable throughout.
2. Owing to control character errors in the Microsoft Word 6.0 file (with embedded PowerPoint drawings) as obtained, the document had to be imported as ASCII text and the drawings done over again--one in PowerPoint and two as tables. The document was also checked against a FAXed version.
3. Several words were changed to coincide with idiomatic (USA) English. A number of words incorrectly shown as hyphenated, some grammar and punctuation errors, and capitalization of titles were all corrected.
4. A few corrections were made based upon examination of English figures and characters present in the original Japanese text.

RCR STD-33A

SECTION 1 GENERAL CONDITIONS

1.1 Overview

This Standard Specification covers the radio stations for use in the low power data communication system stipulated in the Regulations for Enforcement of Radio Law, Article 6, Item 4, Number 4; and specifies "Radio Equipment for Low Power Data Communications System Radio Stations" (including those connected with telecommunication circuit equipment) that perform radio communication for data transmission.

1.2 Scope

The Low Power Data Communication System Radio Station consists of radio equipment, data terminal equipment (including those connected with telecommunication circuit equipment), and other related equipment as shown in Figure 1.1.

The Standard Specification specifies said radio equipment.

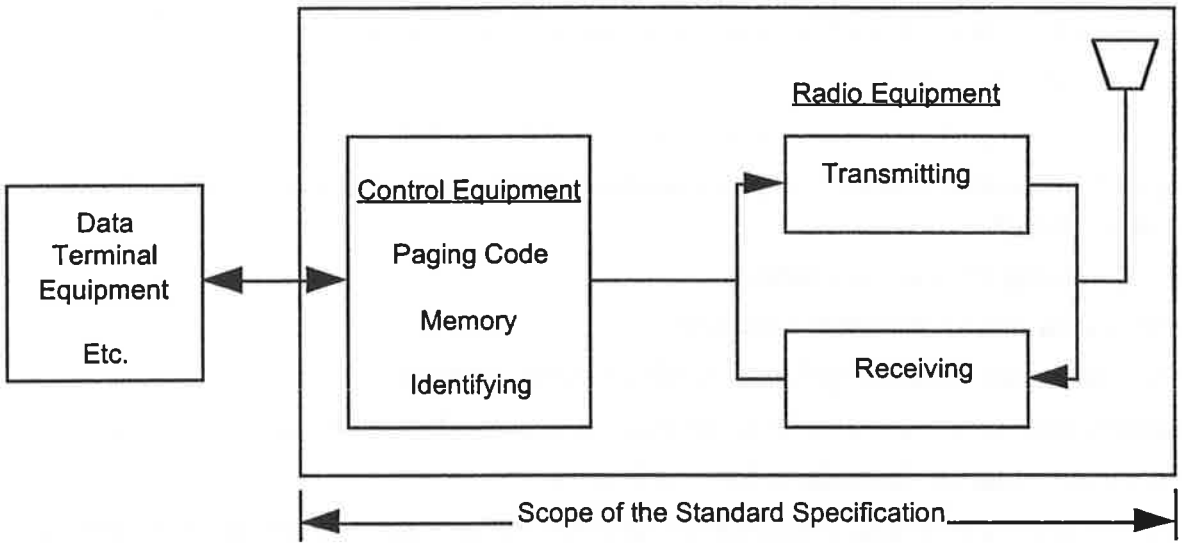

Figure 1.1
Configuration of Radio Equipment
Installed at Low Power Data Communication System Radio Station

1.3 Applicable Documents

For the Standard Specification, the term "Enforcement" refers to Regulations for the Enforcement of Radio Law, "Equipment" refers to Radio Equipment Law, "Technical Conformance" refers to rules related to technical standard conformance certificates for specified radio equipment, "Terminal" refers to Terminal Facilities Law, "Terminal Technical Conformance" refers to rules related to technical standard conformance approval for terminal equipment, and "Announcement" refers to announcements made by the Ministry of Post and Telecommunications.

SECTION 2 STANDARD SYSTEM

2.1 Overview of the System

The Low Power Data Communication System is a system that performs radio transmission of digitized information signals in the bit rate range of 256 Kbps up to nearly 2 Mbps by the use of spread spectrum technologies.

Note, however, that the Standard Specification does not specify the conditions for communication protocols.

2.2 Configuration of the System

No particular system configuration is specified.

SECTION 3 TECHNICAL REQUIREMENTS FOR THE RADIO EQUIPMENT

3.1 General Conditions

3.1.1 Communication system (Equipment, Article 49, Item 20)

Simplex transmission systems, simplex operation, half duplex operation, or full duplex operation may be employed.

3.1.2 Contents of Communication

Digitized data signals shall be transmitted.

3.1.3 Applicable Frequency Band (Enforcement, Article 6)

Frequency band to be used shall be in the frequency range of 2471 MHz to 2497 MHz.

3.1.4 Environmental Conditions for Installation

No particular environmental conditions are specified for installation of the radio equipment.

3.2 Transmitting Equipment

3.2.1 Antenna Power (Enforcement, Article 6)

Antenna power shall be 10 mW or less per MHz.

Instantaneous maximum value of average power shall be equal to or less than; [rated value of antenna power] x [spread bandwidth (MHz)] divided by [frequency (MHz) equal to symbol rate of information signals].

In this case, any spread bandwidth equal to or less than 1 MHz shall be calculated as 1 MHz.

Note that, when absolute gain of transmitting antenna exceeds 2.14 dB, a power equivalent to the excess value shall be reduced.

3.2.2 Deviation Allowed with Respect to Antenna Power (Equipment, Article 14)

The deviation shall stay within upper limit plus 20% and lower limit minus 80%.

3.2.3 Deviation Allowed with Respect to Frequency (Equipment, Appended Table No. 1)

The deviation shall stay within +/-50 x 10 .

3.2.4 Modulation Technology

3.2.4.1 Spread Spectrum Modulation (Equipment, Article 49, Item 20)

Spread spectrum modulation for spreading spectrum, in principle, shall utilize either a direct spread method (a method in which spectrum is spread by directly multiplying a signal on which the spectrum is spread by a signal with wider bandwidth, hereafter referred to as "DS method"), a frequency hopping method (a method in which the carrier frequency of a main signal modulated by an information signal is randomly and discretely switched over and swept in response to the spread signal within a given frequency band, hereafter referred to as "FH method"), or a combined method of DS and FH methods.

3.2.4.2 Information Modulation

No particular method is specified with respect to information modulation method for transmission of information.

3.2.5 Transmission Bit Rate

No particular transmission bit rate is specified.

3.2.6 Spurious Emission Intensity (Equipment, Article 7): The intensity in frequency "f" excepting the used frequency band shall be as follows:

3.2.6.1 2458 MHz</=f<2471 MHz, and 2497 MHz<f</=2510 MHz, not more than 25 μW

3.2.6.2 2458 MHz>f and 2510 MHz<f, not more than 2.5 μW.

3.2.7 Allowance for occupied frequency bandwidth (Equipment, Appended Table No. 2)

Required frequency bandwidth (a minimum value of occupied frequency bandwidth adequate for securing information transmission with rate and quality required in the used method under specified conditions with respect to a given emission type) shall be not more than 26 MHz.

3.2.8 Spread Bandwidth (Equipment, Article 49, Item 20)

Spread bandwidth (each of upper limit and lower limit frequency bandwidths in which each average power radiated above its upper frequency limit and radiated below its lower frequency limit is equal to 5% of the total average power radiated by each of given emissions, and the same shall apply to all descriptions that follow) shall be not less than 500 KHz.

3.2.9 Spread Ratio (Equipment, Article 49, Item 20)

Spread ratio (a ratio of spread bandwidth with reference to a frequency equal to the symbol rate of an information signal--and the same shall apply to all descriptions that follow) shall be not less than 10.

3.3 Receiving Equipment

3.3.1 Limits of derivatively emitted radio waves or the like (Equipment, Article 24)

Radio waves or the like produced derivatively shall be within the limits of not more than 4 nW for frequencies below 1 GHz and not more than 20 nW for frequencies equal to or more than 1GHz.

3.3.2 Others

No particular adjacent channels selectivity, intermodulation characteristics, nor spurious response depending on spread spectrum methods are specified.

3.4 Control Equipment

The control equipment shall be provided with the following equipment and conform to respective conditions.

3.4.1 Paging Code Memory Equipment (Equipment, Article 9, Item 2) (Announcement No. 759, 1992)

The paging code shall be a decimal 12-digit number designated by the Minister of Posts and Telecommunications, and the paging code memory equipment shall conform to the following requirements:

3.4.1.1 Functions of Paging Code Memory Equipment

3.4.1.1.1 The equipment shall not permit radio wave to be emitted if it does not memorize a paging code.

3.4.1.1.2 The equipment shall not allow the memorized paging code to be deleted easily.

3.4.1.1.3 The equipment shall not allow ready removal thereof.

3.4.1.1.4 The equipment shall be free of trouble in its operation if it is subjected to any usual temperature or humidity change, vibration or shock.

3.4.1.2 Conditions of Transmitted Signal

3.4.1.2.1 Transmitted signal shall have the same modulation method and modulation rate as those of the transmitting equipment and re-ceiling equipment in the main unit.

3.4.1.2.2 Transmitted signal shall be composed of the bit synchronization signal, frame synchronization signal, and paging signal arranged in the format specified in Figure 3.1.

Bit Synchronization Signal	Frame Synchronization Signal	Paging Signal
Not less than 24 bits	31 bits	63 bits

Figure 3.1
Signal Format

3.4.1.2.3 The bit synchronization signal shall comprise a 24-bit or longer code with '1' and '0' alternately arranged.

3.4.1.2.4 The frame synchronization signal shall be a 31-bit M-system code made up in the following format:

"0001101110101000010010110011111"

3.4.1.2.5 . The identifying signals shall be:

"a62, a61, a60, a59, a58, a57, a56, a55, a54, a53, a52, a51, a50,
a49, a48, a47, a46, a45, a44, a43, a42, a41, a40, a39, a38, a37, a36, a35, a34, a33, a32, a31, a30, a29,
a28, a27, a26, a25, a24, a23, a22, a21, a20, a19, a18, a17, a16, a15, a14, a13, a12, a11, a10, a9, a9,
a8, a7, a6, a5, a4, a3, a2, a1, a0"

Note that, with respect to the signals from a up to a , their digits specified below shall be coefficients of items from 62th order to 0 order of a polynomial on the 2's finite field:

$$X^{12} \left(\sum_{i=0}^{50} bi\ X^i\right) + R\,(X)$$

Note that the signals from b up to b shall be the number of each digit from the 1st digit to 48th digit when a paging code represented by a 12-digit number is converted into a binary number in accordance with Table 3.1, and the signals from b to b shall be 0s (zeros).

In addition, R (X) shall be a remainder polynomial when:

$$X^{12} \left(\sum_{I=0}^{50} bi\ X^{i}\right) \text{ is divided by } (X12 + X10 + X8 + X5 + X4 + X3 + 1).$$

Table 3.1 Binary Conversion of Paging Codes

Paging designation number	1	2	3	4	5	6	7	8	9	0
Binary number	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100

3.4.2 Identifying Equipment (Equipment, Article 9, Item 2)(Announcement No. 759, 1992)

Radio equipment to be connected with telecommunication circuit equipment shall be provided with identifying equipment, allowing detection of a paging signal of the communicating radio station in the received radio wave.

3.4.3. Circuit Connecting Procedures

No particular circuit connecting procedure is specified.

3.5 . Connection with Telecommunication

Circuits Radio equipment to be connected with telecommunication circuit equipment shall conform to the following conditions.

3.5.1 Identifying Code (Announcement, No. 266, 1993)

The identifying code shall be composed of 19 bits or more.

3.5.2 Radio Interference Protection Function (Announcement, No. 266, 1993)

Determination of whether radio wave frequency to be used is unoccupied shall be made by detecting radio waves emitted from other radio stations, or by calculating the received signal and the signal for spreading and detecting signal level.

3.5.3 Conditions for Interfacing with Telecommunication Circuit Equipment

The conditions for interfacing with telecommunication circuit equipment shall conform to the technical standards stipulated in Terminal Facilities Law (including those technical conditions stipulated by Type I telecommunications carriers).

3.6 Antenna

3.6.1 Antenna Structure

No particular antenna structure is specified.

3.6.2 Antenna Gain

No particular antenna gain is specified.

3.7 Other Conditions (Terminal, Article 8, Item 2)

3.7.1 Frame (Announcement No. 266, 1993)

3.7.1.1 Radio equipment to be used shall be housed in a single frame which shall not allow ready opening. Note, however, that those satisfying the following conditions are not required to be housed in a single frame:

3.7.1.1.1 High frequency component and modulation component excluding antenna system shall not allow ready opening.

3.7.1.1.2 Paging code memory equipment and identifying equipment shall not allow ready removal.

3.7.1.2 Radio equipment not required to be housed in a single frame shall be as follows:

3.7.1.2.1 Power supplying equipment, telephone transmitter, and telephone receiver

3.7.1.2.2 Antenna dedicated to radio wave reception

3.7.1.2.3 Operating panel, display panel, voice volume adjuster and the like equipment

3.7.2 Indications for Paging Code and Others (Enforcement, Article 6, Item 3)

Indications of designated formats, designated paging codes, and specified symbol marks shall be made at easy-to-view positions on radio equipment. Note that paging codes may be indicated inside the frame. In this case, an indication to this effect shall be made.

3.7.3 Indications Related to Technical Standard Conformance Certificate (Technical Conformance, Article 6)

Indications related to technical standard conformance certificate shall be made in the specified format at easy-to-view positions on radio equipment.

3.7.4 Indications Related to Technical Standard Conformance Approval for Terminal Equipment (Terminal Technical Conformance, Article 7)

For radio equipment to be connected with telecommunication circuit equipment, indications related to technical standard conformance approval shall be made in the specified format at easy-to-view positions on such radio equipment.

SECTION 4 MEASURING METHODS

4.1 Transmitting Equipment

3.4.1 Frequency

3.4.1.1 In the case of radio equipment with antenna measuring terminal:

Measurement of spectrum spread condition in the stationary condition shall be made, by the use of a frequency meter, for its average value (for burst waves, average value in bursts).

Note that the average value may be determined as a center frequency of occupied frequency bandwidth.

3.4.1.2 In the case of radio equipment without antenna measuring terminal:

Measurement of spectrum spread condition shall be made in the same manner as 3.4.1.1 with a frequency meter coupled with a RF coupler or an antenna.

3.4.2 Antenna power

3.4.2.1 In the case of radio equipment with antenna measuring terminal:

Measurement of average power in 1 MHz bandwidth shall be made in a frequency with maximum average power.

Measurement of average power obtained when standard coded test signal (511-bit long binary pseudo-noise system: 9-stage FN, the same shall apply to all descriptions that follow) is added as an input signal shall be made, by the use of a spectrum analyzer, at the RF output component, or at the video output component with an waveform recorder connected.

Mean time for determination of the average power shall be 0.4 seconds for the DS method and [spread bandwidth (MHz)] x 0.4 divided by [spread bandwidth (MHz) when FH is stationary] (seconds) for other methods.

In this case, the resolution bandwidth of the spectrum analyzer shall be set to 1 MHz.

3.4.2.2 In the case of radio equipment without antenna measuring terminal:

Measurement shall be made in an anechoic chamber, or an open site or tent site where earth reflected waves are suppressed, with the measuring distance of 3 m, by the use of an equipment of the same type as the measured equipment and by the application of a calibrated RF coupler, with all other conditions the same as 3.2.4.1 above.

In this case, a directional antenna shall be used for the measuring antenna at the test site.

In addition, when the size of an equipment to be measured exceeds 60 cm in length, the measuring distance shall be five times as long as or longer than the equipment length.

3.4.3 Spurious Emission Intensity

3.4.3.1 In the case of radio equipment with antenna measuring terminal:

Measurement of average power of spurious component (for burst waves, average value in bursts) obtained when standard coded test signal is added as an input signal shall be made, by the use of a spectrum analyzer.

In this case, the resolution bandwidth of the spectrum analyzer shall be set to 1 MHz.

3.4.3.2 In the case of radio equipment without antenna measuring terminal

Measurement shall be made in an anechoic chamber, or an open site or tent site where earth reflected waves are suppressed, with the measuring distance of 3 m, by the use of an equipment of the same type as the measured equipment and by the application of a RF coupler calibrated per frequency to be measured, with all other conditions the same as 3.4.3.1 above.

In this case, a directional antenna shall be used for the measuring antenna at the test site.

In addition, when the size of an equipment to be measured exceeds 60 cm in length, the measuring distance shall be five times as long as or longer than the equipment length.

When measurement is required at a frequency equal to or less than 100 MHz, measuring distance shall be 30 cm.

Note that, when measurement is performed without an antenna measuring terminal, the measurement will include frame radiation.

3.4.4 Occupied Frequency Bandwidth

3.4.4.1 In the case of radio equipment with antenna measuring terminal

Measurement shall be made for a frequency bandwidth with each sum of power at upper and lower limit portions of spectrum distribution being 0.5 % of each total power when a standard coded test signal is added as an input signal, by the use of a spectrum analyzer.

In this case, the spectrum analyzer shall be set to resolution bandwidth of 100 kHz, with its indication in the maximum value holding mode, and to frequency span of 100 MHz.

3.4.4.2 In the case of radio equipment without antenna measuring terminal

Measurement shall be made in the same manner as 3.4.4.1, with an adequate RF coupler or antenna connected.

3.4.5 Spread Bandwidth

3.4.5.1 In the case of radio equipment with antenna measuring terminal:

The same measuring methods as those for the occupied frequency bandwidth shall apply.

Note that measurement shall be made for a frequency bandwidth with each sum of power at upper and lower limit portions of spectrum distribution being 0.5 % of each total power when a standard coded test signal is added as an input signal.

3.4.5.2 In the case of radio equipment without antenna measuring terminal:

The same measuring methods as those for the occupied frequency bandwidth shall apply.

3.4.6 Spread ratio

For spread ratio, a value obtained after dividing spread frequency bandwidth (Hz) by a frequency (Hz) equal to the symbol rate of information signal shall be determined.

4.2 Receiving Equipment

4.2.1 Limits of Derivatively Emitted Radio Waves or the Like

4.2.1.1 In the case of radio equipment with antenna measuring terminal:

Measurement shall be made by the use of a spectrum analyzer.

In this case, the resolution bandwidth of the spectrum analyzer shall be set to 1 MHz.

4.2.1.2 In the case of radio equipment without antenna measuring terminal:

The same measuring methods as those for the spurious emission intensity measurement of the transmitting equipment shall apply.

PRELIMINARY INTERPRETATION & ANALYSIS

1. 3.2.1 "Antenna Power" apparently refers to the (RMS) power entering the antenna. This interpretation is prompted by the comment two sentences later regarding the gain over an isotropic radiator of a half wave linear antenna (2.1 dB). "10 mW/MHz" is taken to represent a power density.

2. 3.2.1 "Instantaneous maximum value of average power" is taken to be basically the same as Peak Envelope Power, or Peak Envelope RMS power. This formula is interpreted to mean: (Power Density)(Spread Bandwidth)/Symbol Rate.
3. 3.2.1 "...equal or less than 1 MHz..." is interpreted to discriminate against data of very low symbol rate (less than approximately 100 Ksymbols/sec).
4. 3.2.2 This statement is unclear. "Deviation" may mean Tolerance. The statement seems to say that there is not only a maximum, but a minimum legal power density. This contradicts 3.2.1, which says, "Antenna power shall be 10mW or less per MHz." Possibly, it refers to tolerance with respect to published catalog figures.
5. 3.2.3 Similar comment to 3.2.2--plus: "...stay within +/-50 x 10 ." probably means: stay within +/-50(10^{-6}), or 50 ppm of published figure.
6. 3.2.6.1, 2 The power figures here may also refer to power density, for instance, 25 μW/MHz, or they may mean total integrated power contained within the designated segments of the spectrum. If the former be the case, the power density just outside the intended operating band must be 26 dB down from the in-band value, which may not be easy to implement for DS operation. If the latter be the case, the power density can be higher close to the band edges. Specifying absolute power (or density) levels rather than relative levels, the overall philosophy here echoes the "Restricted Band" case of FCC Rules, which discriminates against low power operation.
7. 3.2.8 This paragraph appears difficult to interpret. It seems to indicate that regardless of how slow the data is, it must be spread to at least +/-500 KHz.
8. 3.3.1 The term "derivatively" probably refers to unintentional or unwanted radiated energy which reaches the antenna from the receiver's local oscillator circuitry. Rather than power density, it probably refers to levels of monochromatic components. The power levels quoted are -54 dBm below 1 GHz and -47 dBm above 1 GHz, neither of which would be any more difficult to comply with than FCC Rules.
9. The entire Section 3.4 is designated "Paging Code Memory Equipment" which apparently does not pertain to the Wireless LAN service.
10. The entire Section 3.5 is designated "Connection with Telecommunication" which apparently does not pertain to the Wireless LAN service.
11. 3.4.3.2 The text which says "When measurement is required at a frequency less than 100 MHz, measuring distance shall be 30 cm" most probably should say: ...30 meters.

The Author will attempt to resolve ambiguities and incongruities discovered herein by further inquiries into the translation.

PRELIMINARY CONCLUSIONS

1. 3.2.4.1 Both Direct Sequence and Frequency Hopping is permitted.
2. 3.2.9 The minimum DS spread ratio (chips/symbol) is similar to FCC Part
3. 3.6 There is no regulation of antenna type (but see 3.2.1, fourth text paragraph).

4. 3.2.1 There is no power penalty for Frequency Hopping; as this paragraph refers to "instantaneous value of average power". See also 3.4.2.1, third text paragraph.
5. 3.4 Provision is made for both conductive and radiative testing.

The Author's overall preliminary conclusion is that the Japanese Radio Laws for this band do permit operation of equipment having similar overall performance specifications as that designed to meet the European and USA Regulations.

ACKNOWLEDGMENT

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