

# **TIA DOCUMENT**

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## **Introduction to cdma2000® Spread Spectrum Systems**

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### **TIA-2000.1-D**

(Revision of TIA/IS-2000.1-C)

MARCH 2004

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**CONTENTS**

1 OVERVIEW ..... 1-1

1.1 The cdma2000 Family of Standards ..... 1-1

1.1.1 Purpose ..... 1-1

1.1.2 Architecture ..... 1-2

1.2 Relationship to TIA/EIA-95-B ..... 1-5

1.3 cdma2000 References ..... 1-5

1.4 Informative References ..... 1-7

1.5 Support of Multiple Band Classes ..... 1-8

2 COMMON ASPECTS ..... 2-1

2.1 Verbal Forms ..... 2-1

2.2 Channel Naming Conventions ..... 2-1

2.2.1 Logical Channel Naming Convention ..... 2-1

2.2.2 Physical Channel Naming Convention ..... 2-1

2.3 Definitions of Terms ..... 2-3

2.4 Constants ..... 2-3

**FIGURES**

Figure 1 cdma2000 Architecture ..... 1-2

Figure 2 cdma2000 Architecture (Mobile Station) ..... 1-4

**TABLES**

Table 1. Naming Conventions for Logical Channels ..... 2-1

Table 2. Physical Channel Names ..... 2-2

Table 3. cdma2000 Constants ..... 2-3

- 1
- 2 No text
- 3

## 1 OVERVIEW

### 1.1 The cdma2000 Family of Standards

The cdma2000<sup>®1</sup> family of standards includes core air interface, minimum performance, and service standards (see 1.3). The cdma2000 air interface standards specify a spread spectrum radio interface that uses Code Division Multiple Access (CDMA) technology to meet the requirements for Third Generation (3G) wireless communication systems. The core air interface standards in the family are [1, 2, 3, 4, 5]. In addition, the family includes a standard [6] that specifies analog operation, to support dual-mode mobile stations and base stations.

Throughout the remainder of this document, use of the term cdma2000 refers to the cdma2000 family.

#### 1.1.1 Purpose

The technical requirements contained in cdma2000 form a compatibility standard for CDMA systems. They ensure that a mobile station can obtain service in a system manufactured in accordance with the cdma2000 standards. The requirements do not address the quality or reliability of that service, nor do they cover equipment performance or measurement procedures.

Compatibility, as used in connection with cdma2000, is understood to mean: any cdma2000 mobile station is able to place and receive calls in cdma2000 or IS-95 systems. Conversely, any cdma2000 system is able to place and receive calls for cdma2000 and IS-95 mobile stations. In a subscriber's home system, all call placement is automatic. Similarly, it is preferable for call placement to be automatic when a mobile station is roaming.

To ensure compatibility, both radio system parameters and call processing procedures are specified. The sequence of call processing steps that the mobile stations and base stations execute to establish calls is specified, along with the digital control messages and, for dual-mode systems, the analog signals that are exchanged between the two stations.

The base station is subject to different compatibility requirements than the mobile station. Radiated power levels, both desired and undesired, are fully specified for mobile stations, in order to control the RF interference that one mobile station can cause another. Base stations are fixed in location and their interference is controlled by proper layout and operation of the system in which the station operates. Detailed call processing procedures are specified for mobile stations to ensure a uniform response to all base stations. Base station procedures, which do not affect the mobile stations' operation, are left to the

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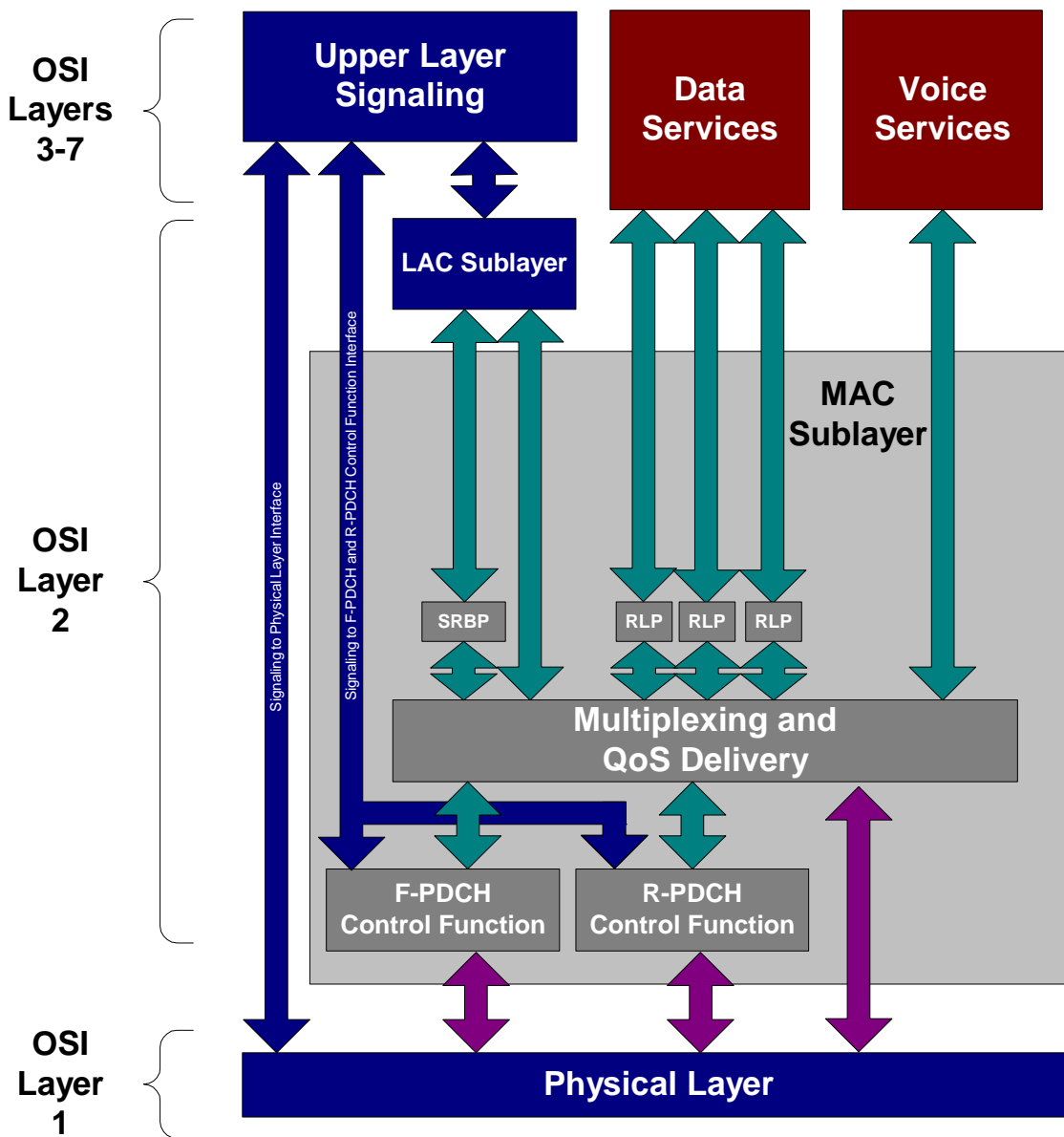
<sup>1</sup> cdma2000<sup>®</sup> is the trademark for the technical nomenclature for certain specifications and standards of the Organizational Partners (OPs) of 3GPP2. Geographically (and as of the date of publication), cdma2000<sup>®</sup> is a registered trademark of the Telecommunications Industry Association (TIA-USA) in the United States.

1 designers of the overall land system. This approach to writing the compatibility  
 2 specification is intended to provide the land system designer with sufficient flexibility to  
 3 respond to local service needs and to account for local topography and propagation  
 4 conditions.

5 cdma2000 includes provisions for future service additions and expansion of system  
 6 capabilities. This release of the cdma2000 family of standards supports Spreading Rate 1  
 7 and Spreading Rate 3 operation (see [2]).

8 1.1.2 Architecture

9 Figure 1 depicts the general architecture of cdma2000. Development of the cdma2000  
 10 family of standards has, to the greatest extent possible, adhered to the architecture by  
 11 specifying different layers in different standards.

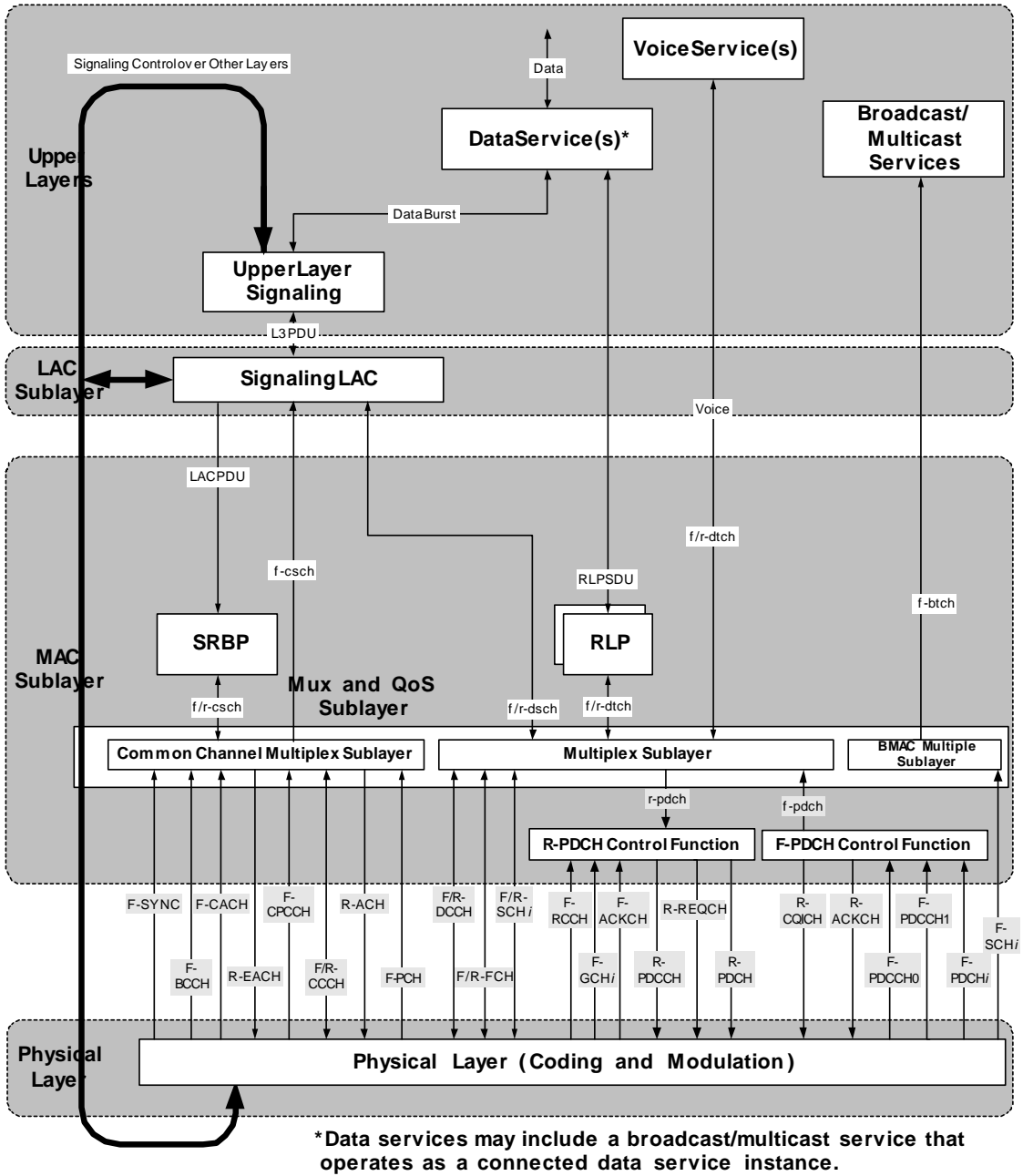


12 **Figure 1 cdma2000 Architecture**

- 1 The physical layer is specified in [2], the MAC in [3], the LAC in [4], and upper layer
- 2 signaling in [5].

1 Figure 2 shows the logical and physical channel relationships from the mobile station  
 2 perspective, and Figure 3 shows the logical and physical channel relationships from the  
 3 base station perspective.

4



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**Figure 2 cdma2000 Architecture (Mobile Station)**

## 1.2 Relationship to TIA/EIA-95-B

cdma2000 provides full backward compatibility with TIA/EIA-95-B. Backward compatibility permits cdma2000 infrastructure to support TIA/EIA-95-B mobile stations and permits cdma2000 mobile stations to operate in TIA/EIA-95-B systems.

The cdma2000 family also supports reuse of existing TIA/EIA-95-B service standards, such as those that define speech services, data services, Short Message Services, and Over the Air Provisioning and Activation services, with the cdma2000 physical layer.

cdma2000 supports handoff of voice and data calls and other services from a TIA/EIA-95-B system to a cdma2000 system:

- At a handoff boundary and within a single frequency band,
- At a handoff boundary and between frequency bands (assuming the mobile station has multi-band capability),
- Within the same cell footprint and within a single frequency band, and
- Within the same cell footprint and between frequency bands (assuming the mobile station has multi-band capability).

cdma2000 supports handoff of voice and data calls and other services<sup>2</sup> from a cdma2000 system to a TIA/EIA-95-B system:

- At a handoff boundary and within a single frequency band,
- At a handoff boundary and between frequency bands (assuming the mobile station has multi-band capability),
- Within the same cell footprint and within a single frequency band, and
- Within the same cell footprint and between frequency bands (assuming the mobile station has multi-band capability).

## 1.3 cdma2000 References

The following list identifies the current versions of the standards in the cdma2000 family of standards.

1. C.S0001-D, *Introduction to cdma2000 Standards for Spread Spectrum Systems*, February, 2004.
2. C.S0002-D, *Physical Layer Standard for cdma2000 Spread Spectrum Systems*, February, 2004.
3. C.S0003-D, *Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems*, February, 2004.
4. C.S0004-D, *Signaling Link Access Control (LAC) Standard for cdma2000 Spread Spectrum Systems*, February, 2004.

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<sup>2</sup> Assuming that the cdma2000 service can be appropriately mapped to a TIA/EIA-95-B service.

- 1 5. C.S0005-D, *Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum*  
2 *Systems*, February, 2004.
- 3 6. C.S0006-D, *Analog Signaling Standard for cdma2000 Spread Spectrum Systems*,  
4 February, 2004.
- 5 7. C.S0009-0, *Speech Service Option Standard for Wideband Spread Spectrum Systems*,  
6 November 1999.
- 7 8. C.S0010-A, *Recommended Minimum Performance Standard for Base Stations Supporting*  
8 *Dual-Mode Spread Spectrum Cellular Mobile Stations*, April 2001.
- 9 9. C.S0011-A, *Recommended Minimum Performance Standards for Dual-Mode Spread*  
10 *Spectrum Cellular Mobile Stations*, April 2001.
- 11 10. C.S0012-0, *Recommended Minimum Performance Standard for Digital Cellular Wideband*  
12 *Spread Spectrum Speech Service Option 1*, March, 2000.
- 13 11. C.S0013-A, *Mobile Station Loopback Service Options Standard*, November 2002.
- 14 12. C.S0015-A, *Short Message Service for Spread Spectrum Systems*, February 2002.
- 15 13. C.S0014-0, *Enhanced Variable Rate Codec, Speech Service Option 3 for Wideband*  
16 *Spread Spectrum Digital Systems*, January 1997.
- 17 14. C.S0014-0-1, *Enhanced Variable Rate Codec, Speech Service Option 3 for Wideband*  
18 *Spread Spectrum Digital Systems – Addendum 1*, August, 1998.
- 19 15. C.S0014-0-2, *Enhanced Variable Rate Codec, Speech Service Option 3 for Wideband*  
20 *Spread Spectrum Digital Systems – Addendum 2*, April 2001.
- 21 16. TIA/EIA/IS-657, *Packet Data Service Option Standard for Wideband Spread Spectrum*  
22 *Systems*, July, 1996.
- 23 17. C.S0016-A, *Over-the-Air Service Provisioning of Mobile Stations in Spread Spectrum*  
24 *Systems*, December 2001.
- 25 18. C.S0017-0, *Data Service Options for Spread Spectrum Systems*, April, 1999.
- 26 19. C.S0017-0-1, *Data Service Options for Spread Spectrum Systems – Addendum 1*,  
27 January 2000.
- 28 20. C.S0017-0-2, *Data Service Options for Spread Spectrum Systems – Addendum 2*, August  
29 2000.
- 30 21. C.S0018-0, *Minimum Performance Standard for the Enhanced Variable Rate Codec,*  
31 *Speech Service Option 3 for Spread Spectrum Digital Systems*, November 1999.
- 32 22. C.S0020-0, *High Rate Speech Service Option 17 for Wideband Spread Spectrum*  
33 *Communication Systems*, February 1998.
- 34 23. C.S0020-0-1, *High Rate Speech Service Option 17 for Wideband Spread Spectrum*  
35 *Communication Systems – Addendum 1*, April 2001.
- 36 24. C.S0021-0, *Recommended Minimum Performance Standard for the High Rate Speech*  
37 *Service Option 17 for Wideband Spread Spectrum Communication Systems*, November  
38 1999.

- 1 25. C.S0022-0, *Position Determination Service Standard for Dual-Mode Spread Spectrum*  
2 *Systems*, March 2001.
- 3 26. C.S0023-0, *Removable User Identity Module (R-UIM) for TIA/EIA Spread Spectrum*  
4 *Systems*, June 2001.
- 5 27. C.R1001-C, *Administration of Parameter Value Assignments for TIA/EIA Wideband*  
6 *Spread Spectrum Systems*, January 2002.
- 7 28. C.R1000-0, *Capabilities Requirements Mapping for cdma2000 Standards*, November  
8 1999.
- 9 29. C.S0057-0, *Band Class Specification for cdma2000 Spread Spectrum Systems*,  
10 February 2004.

#### 11 **1.4 Informative References**

12 The documents listed in this section are for information only.

13 —*American National Standards:*

- 14 1. ANS/TIA/EIA-95-B-99, *Mobile Station-Base Station Compatibility Standard for Wideband*  
15 *Spread Spectrum Cellular Systems*, February, 1999.
- 16 2. ANS/TIA-664.000-B-2003, *Wireless Features Description - Introduction*, August, 2003.

17 —*Standards:*

- 18 3. ITU-T Recommendation P.76, *Determination of Loudness Ratings; Fundamental*  
19 *Principles*, 1988.
- 20 4. ITU-T Recommendation P.78, *Subjective Testing Method for Determination of Loudness*  
21 *Ratings in Accordance with Recommendation P.76: Telephone Transmission Quality*  
22 *Measurements Related to Speech Loudness: Study Group 12*, March 1993.
- 23 5. ITU-T Recommendation P.79, *Calculation of Loudness Ratings for Telephone Sets :*  
24 *Telephone Transmission Quality Measurements Related to Speech Loudness: Study Group*  
25 *12*, March 1993.
- 26 6. TIA-660, *Uniform Dialing Procedures and Call Processing Treatment for Cellular Radio*  
27 *Telecommunications*, July 1996.
- 28 7. ICD-GPS-200, *NAVSTAR GPS Space Segment/Navigation User Interfaces*, Interface  
29 Control Document (ICD), Revision B, Unclassified, U.S. Air Force Space Division, Los  
30 Angeles Air Force Station, CA, July 1991.
- 31 8. IEEE Standard 269-1992, *IEEE Standard Methods for Measuring Transmission*  
32 *Performance of Analog and Digital Telephone Sets*, 1992.

33 —*Bulletins:*

- 34 9. TSB51, *Cellular Radio-Telecommunications Intersystem Operations: Authentication,*  
35 *Signaling Message Encryption and Voice Privacy*, May 1993.
- 36 10. TSB64, *IS-41-B Support for Dual-Mode Wideband Spread Spectrum Mobile Stations*,  
37 January 1994.

1 —*Other:*

2 11. *Total Access Communications System Mobile Station – Land Station Compatibility*  
3 *Specification*, Issue 4, Amendment 1, Department of Trade and Industry, Radio  
4 communications Division, London, October 1991.

5 12. RCR STD-36, *Analog Cellular Telecommunication System Based On TACS Method*,  
6 October 1993.

7 —*Books:*

8 13. Knuth, Donald N., *The Art of Computer Programming*, 3 volumes, Reading, MA, Addison-  
9 Wesley, 1998.

10 14. Park, Stephen K., and Miller, Keith W., “Random Number Generators: Good Ones are  
11 Hard to Find,” *Communications of the ACM*, vol. 31, no. 10, October 1988.

## 12 **1.5 Support of Multiple Band Classes**

13 The cdma2000 family of standards supports operation in all the band classes defined in  
14 [29]. Signaling support is provided to enable transitions between band classes (e.g.,  
15 handoffs, service redirections) for mobile stations that are capable of operating in multiple  
16 band classes.

17

1

2 No text.

3



## 2 COMMON ASPECTS

### 2.1 Verbal Forms

The following verbal forms are used in all cdma2000 standards. “Shall” and “shall not” identify requirements to be followed strictly to conform to the standard and from which no deviation is permitted. “Should” and “should not” indicate that one of several possibilities is recommended as particularly suitable, without mentioning or excluding others; that a certain course of action is preferred but not necessarily required; or (in the negative form) that a certain possibility or course of action is discouraged but not prohibited. “May” and “need not” indicate a course of action permissible within the limits of the standard. “Can” and “cannot” are used for statements of possibility and capability, whether material, physical, or causal.

### 2.2 Channel Naming Conventions

Many cdma2000 standards refer to logical channels, physical channels, or both. The following naming conventions apply to all cdma2000 standards.

#### 2.2.1 Logical Channel Naming Convention

A logical channel name consists of three lower case letters followed by “ch” (channel). A hyphen is used after the first letter. Table 1 shows the naming conventions for the logical channels that are used in this family of standards.

**Table 1. Naming Conventions for Logical Channels**

| First Letter       | Second Letter        | Third letter         |
|--------------------|----------------------|----------------------|
| <b>f</b> = Forward | <b>d</b> = Dedicated | <b>t</b> = Traffic   |
| <b>r</b> = Reverse | <b>c</b> = Common    | <b>s</b> = Signaling |

For example, the logical channel name for the Forward Dedicated Traffic Channel is f-dtch.

#### 2.2.2 Physical Channel Naming Convention

Physical channels are represented by upper case abbreviations. As in the case of logical channels, the first letters in the names of the channels indicate the direction of the channel (i.e., forward or reverse) and is followed by a hyphen. Table 2 shows the names and meanings of all the physical channels designated in cdma2000.

1  
2**Table 2. Physical Channel Names**

| <b>Channel Name 1</b> | <b>Physical Channel</b>                    |
|-----------------------|--|
| F/R-FCH               | Forward/Reverse Fundamental Channel        |
| F/R-DCCH              | Forward/Reverse Dedicated Control Channel  |
| F/R-SCCH              | Forward/Reverse Supplemental Code Channel  |
| F/R-SCH               | Forward/Reverse Supplemental Channel       |
| F-PCH                 | Paging Channel                             |
| F-QPCH                | Quick Paging Channel                       |
| R-ACH                 | Access Channel                             |
| F/R-CCCH              | Forward/Reverse Common Control Channel     |
| F/R-PICH              | Forward/Reverse Pilot Channel              |
| F-APICH               | Dedicated Auxiliary Pilot Channel          |
| F-TDPICH              | Transmit Diversity Pilot Channel           |
| F-ATDPICH             | Auxiliary Transmit Diversity Pilot Channel |
| F-SYNCH               | Sync Channel                               |
| F-CPCCH               | Common Power Control Channel               |
| F-CACH                | Common Assignment Channel                  |
| R-EACH                | Enhanced Access Channel                    |
| F-BCCH                | Broadcast Control Channel                  |
| F-PDCH                | Forward Packet Data Channel                |
| F-PDCCH               | Forward Packet Data Control Channel        |
| R-ACKCH               | Reverse Acknowledgement Channel            |
| R-CQICH               | Reverse Channel Quality Indicator Channel  |
| F-ACKCH               | Forward Acknowledgement Channel            |
| F-GCH                 | Forward Grant Channel                      |
| F-RCCH                | Forward Rate Control Channel               |
| R-PDCH                | Reverse Packet Data Channel                |
| R-PDCCH               | Reverse Packet Data Control Channel        |
| R-REQCH               | Reverse Request Channel                    |

1 The notations “F/R” and “Forward/Reverse” represent two  
 2 different physical channels (i.e., one forward channel and  
 3 one reverse channel)

4 For example, the physical channel name for the Forward Fundamental Channel is F-FCH.

### 5 **2.3 Definitions of Terms**

6 Each cdma2000 volume contains a definition of terms proper to that volume. An attempt  
 7 has been made to use the same definitions for the same terms across the family of  
 8 volumes.

### 9 **2.4 Constants**

10 Table 3 lists the constants defined in various cdma2000 volumes and identifies the  
 standard in which the constant is defined.

**Table 3. cdma2000 Constants**

| Constant         | Reference |
|------------------|-----------|
| N <sub>1m</sub>  | [4]       |
| N <sub>2m</sub>  | [5]       |
| N <sub>3m</sub>  | [5]       |
| N <sub>4m</sub>  | [5]       |
| N <sub>5m</sub>  | [5]       |
| N <sub>6m</sub>  | [5]       |
| N <sub>7m</sub>  | [5]       |
| N <sub>8m</sub>  | [5]       |
| N <sub>9m</sub>  | [5]       |
| N <sub>10m</sub> | [5]       |
| N <sub>11m</sub> | [5]       |
| N <sub>12m</sub> | [5]       |
| N <sub>13m</sub> | [5]       |
| N <sub>14m</sub> | [4]       |
| N <sub>15m</sub> | [4]       |
| N <sub>16m</sub> | [5]       |
| N <sub>17m</sub> | [5]       |
| N <sub>18m</sub> | [5]       |
| T <sub>1b</sub>  | [5]       |

|      |     |
|------|-----|
| T2b  | [5] |
| T3b  | [5] |
| T4b  | [5] |
| T4b  | [5] |
| T1m  | [4] |
| T2m  | [4] |
| T3m  | [4] |
| T4m  | [4] |
| T5m  | [5] |
| T20m | [5] |
| T21m | [5] |
| T30m | [5] |
| T31m | [5] |
| T32m | [5] |
| T33m | [5] |
| T34m | [5] |
| T35m | [5] |
| T36m | [5] |
| T37m | [5] |
| T38m | [5] |
| T39m | [5] |
| T40m | [5] |
| T41m | [5] |
| T42m | [5] |
| T50m | [5] |
| T51m | [5] |
| T52m | [5] |
| T53m | [5] |
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| T55m | [5] |
| T56m | [5] |

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| T57m | [5] |
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| T60m | [5] |
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| T62m | [5] |
| T63m | [5] |
| T64m | [5] |
| T65m | [5] |
| T66m | [5] |
| T68m | [5] |
| T69m | [5] |
| T70m | [5] |
| T71m | [5] |
| T72m | [5] |
| T73m | [5] |
| T74m | [5] |
| T75m | [4] |
| T76m | [4] |
| T77m | [4] |
| T78m | [5] |
| T79m | [5] |
| T80m | [5] |
| T81m | [5] |





