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Introduction to cdma2000 Spread Spectrum Systems

Release A

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 1-4
1.3 cdma2000 References 1-4
1.4 Informative References 1-6
1.5 Support of Multiple Band Classes 1-7
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 2-2
2.4 Constants 2-2

FIGURES

Figure 1. cdma2000 Architecture 1-3

TABLES

Table 1. Naming Conventions for Logical Channels 2-1
Table 2. Physical Channel Names 2-1
Table 3. cdma2000 Constants 2-2

No text

1 OVERVIEW

1.1 The cdma2000 Family of Standards

The cdma2000 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 designers of the overall land system. This approach to writing the compatibility specification is intended to provide the land system designer with sufficient flexibility to respond to local service needs and to account for local topography and propagation conditions.

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

1.1.2 Architecture

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

The physical layer is specified in [2], the medium access control (MAC) layer in [3], the link access control (LAC) layer in [4], and upper layer signaling in [5].

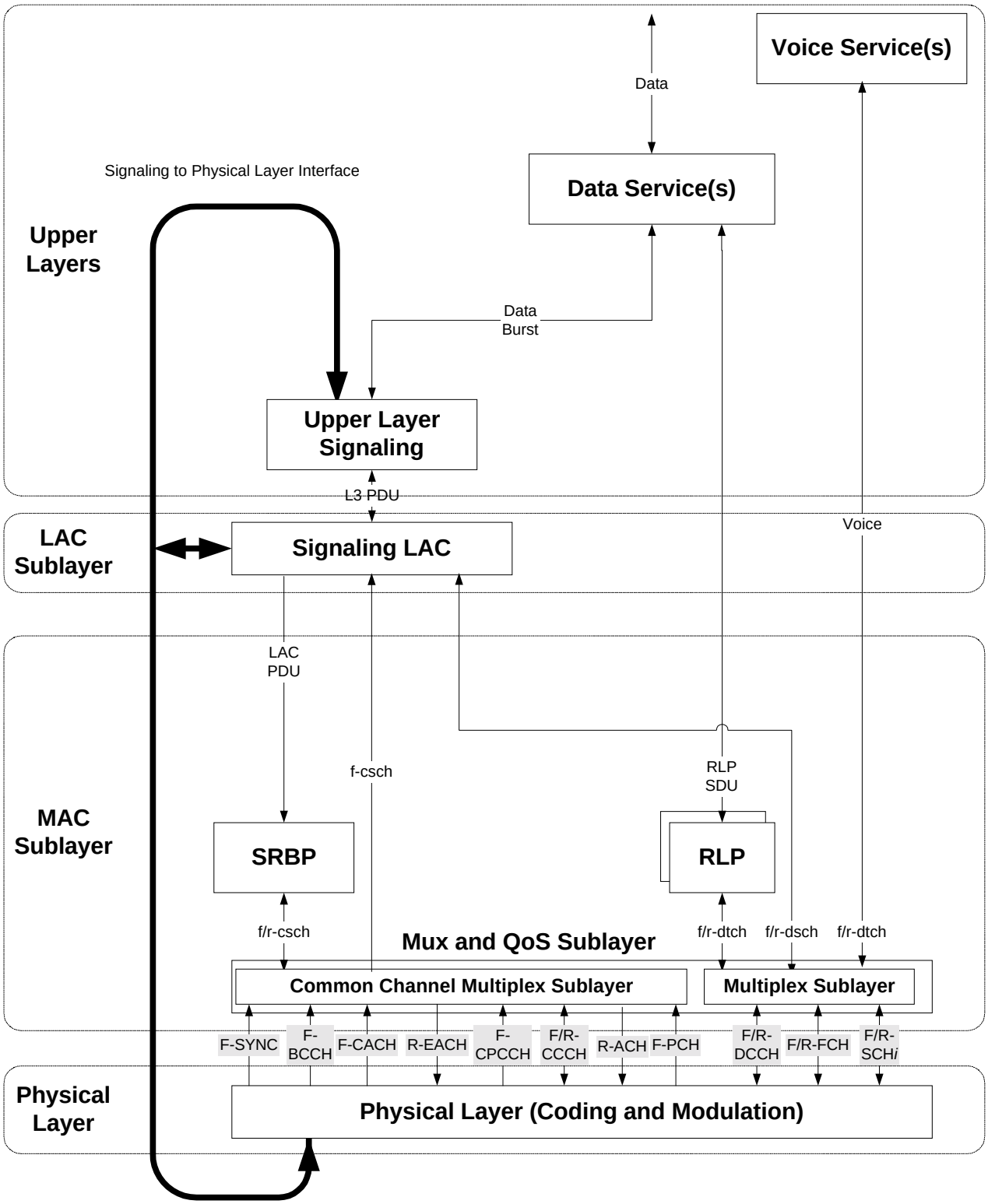

Figure 1. cdma2000 Architecture

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[1] 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-A, *Introduction to cdma2000 Standards for Spread Spectrum Systems*, June, 2000.
2. C.S0002-A, *Physical Layer Standard for cdma2000 Spread Spectrum Systems*, June, 2000.
3. C.S0003-A, *Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems*, June, 2000.
4. C.S0004-A, *Signaling Link Access Control (LAC) Standard for cdma2000 Spread Spectrum Systems*, June, 2000.

[1] Assuming that the cdma2000 service can be appropriately mapped to a TIA/EIA-95-B service.

5. C.S0005-A, *Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems*, June, 2000.

6. C.S0006-A, *Analog Signaling Standard for cdma2000 Spread Spectrum Systems*, June, 2000.

7. C.S0009-0, *Speech Service Option Standard for Wideband Spread Spectrum Systems*, August 1998.

8. C.S0010-0, *Recommended Minimum Performance Standard for Base Stations Supporting Dual-Mode Spread Spectrum Cellular Mobile Stations*, September, 1999.

9. C.S0011-0, *Recommended Minimum Performance Standards for Dual-Mode Spread Spectrum Cellular Mobile Stations*, June, 1999.

10. C.S0012-0, *Recommended Minimum Performance Standard for Digital Cellular Wideband Spread Spectrum Speech Service Option 1*, March, 2000.

11. C.S0013-0, *Mobile Station Loopback Service Options Standard*, August, 1998.

12. C.S0015-0, *Short Message Service for Spread Spectrum Systems*, September, 1999.

13. TIA/EIA/IS-99, *Data Services Option Standard for Wideband Spread Spectrum Digital Cellular System*, July, 1995.

14. C.S0014-0, *Enhanced Variable Rate Codec, Speech Service Option 3 for Wideband Spread Spectrum Digital Systems*, January, 1997.

15. C.S0014-0-1, *Enhanced Variable Rate Codec, Speech Service Option 3 for Wideband Spread Spectrum Digital Systems – Addendum 1*, August, 1998.

16. C.S0014-0-2, *Enhanced Variable Rate Codec, Speech Service Option 3 for Wideband Spread Spectrum Digital Systems – Addendum 2*, September, 1999.

17. TIA/EIA/IS-657, *Packet Data Service Option Standard for Wideband Spread Spectrum Systems*, July, 1996.

18. TIA/EIA/IS-683-A, *Over-the-Air Service Provisioning of Mobile Stations in Spread Spectrum Systems*, June, 1998.

19. C.S0017-0, *Data Service Options for Wideband Spread Spectrum Systems*, April, 1999.

20. C.S0017-0-1, *Data Service Options for Wideband Spread Spectrum Systems – Addendum 1*, January, 2000.

21. C.S0018-0, *Minimum Performance Standard for the Enhanced Variable Rate Codec, Speech Service Option 3 for Spread Spectrum Digital Systems*, July, 1998.

22. C.S0020-0, *High Rate Speech Service Option 17 for Wideband Spread Spectrum Communication Systems*, February, 1998.

23. C.S0020-0-1, *High Rate Speech Service Option 17 for Wideband Spread Spectrum Communication Systems – Addendum 1*, September, 1999.

24. C.S0021-0, *Recommended Minimum Performance Standard for the High Rate Speech Service Option 17 for Wideband Spread Spectrum Communication Systems*, February, 1999.

25. C.S0022-0, *Position Determination Service Standard for Dual-Mode Spread Spectrum Systems*, October, 1999.

26. C.S0023-0, *Removable User Identity Module (R-UIM) for TIA/EIA Spread Spectrum Systems*, June, 2000.

27. R.1001-0, *Administration of Parameter Value Assignments for TIA/EIA Wideband Spread Spectrum Systems*, April, 1999.

28. R.0000-0, *Capabilities Requirements Mapping for cdma2000 Standards*, September, 1999.

1.4 Informative References

The documents listed in this section are for information only.

—*American National Standards:*

1. TIA/EIA-95-B, *Mobile Station-Base Station Compatibility Standard for Wideband Spread Spectrum Cellular Systems*, February, 1999.

2. TIA/EIA-664, *Cellular Features Description*, June, 1996.

—*Standards:*

3. ITU-T Recommendation P.76, *Determination of Loudness Ratings; Fundamental Principles*, 1988.

4. ITU-T Recommendation P.78, *Subjective Testing Method for Determination of Loudness Ratings in Accordance with Recommendation P.76: Telephone Transmission Quality Measurements Related to Speech Loudness: Study Group 12*, March 1993.

5. ITU-T Recommendation P.79, *Calculation of Loudness Ratings for Telephone Sets : Telephone Transmission Quality Measurements Related to Speech Loudness: Study Group 12*, March 1993.

6. EIA/IS-19-B, *Recommended Minimum Standards for 800-MHz Cellular Subscriber Units*, May 1988.

7. EIA/IS-20-A, *Recommended Minimum Standards for 800-MHz Cellular Land Stations*, May 1988.

8. TIA/EIA-660, *Uniform Dialing Procedures and Call Processing Treatment for Cellular Radio Telecommunications*, July 1996.

9. ICD-GPS-200, *NAVSTAR GPS Space Segment/Navigation User Interfaces*, Interface Control Document (ICD), Revision B, Unclassified, U.S. Air Force Space Division, Los Angeles Air Force Station, CA, July 1991.

10. IEEE Standard 269-1992, *IEEE Standard Methods for Measuring Transmission Performance of Analog and Digital Telephone Sets*, 1992.

—*Bulletins:*

11. TSB46, *Recommended Minimum Procedures for Validation of Authentication of IS-54-B Mobile Stations*, March 1993.

12. TSB51, *Cellular Radio-Telecommunications Intersystem Operations: Authentication, Signaling Message Encryption and Voice Privacy,* May 1993.

13. TSB64, *IS-41-B Support for Dual-Mode Wideband Spread Spectrum Mobile Stations,* January 1994.

—*Other:*

14. *Total Access Communications System Mobile Station - Land Station Compatibility Specification,* Issue 4, Amendment 1, Department of Trade and Industry, Radiocommunications Division, London, October 1991.

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

—*Books:*

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

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

1.5 Support of Multiple Band Classes

The cdma2000 family of standards supports operation in all the band classes defined in [2]. Signaling support is provided to enable transitions between band classes (e.g., handoffs, service redirections) for mobile stations that are capable of operating in multiple band classes.

No text.

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
f = Forward	**d** = Dedicated	**t** = Traffic
r = Reverse	**c** = Common	**s** = 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.

Table 2. Physical Channel Names

Channel Name [1]	**Physical Channel**
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
1 The notations “F/R” and “Forward/Reverse” represent two different physical channels (i.e., one forward channel and one reverse channel)	

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

2.3 Definitions of Terms

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

2.4 Constants

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_{1m}	[4]
N_{2m}	[5]
N_{3m}	[5]
N_{4m}	[5]
N_{5m}	[5]

N_{6m}	[5]
N_{7m}	[5]
N_{8m}	[5]
N_{9m}	[5]
N_{10m}	[5]
N_{11m}	[5]
N_{12m}	[5]
N_{13m}	[5]
N_{14m}	[4]
N_{15m}	[4]
T_{1b}	[5]
T_{2b}	[5]
T_{3b}	[5]
T_{4b}	[5]
T_{1m}	[4]
T_{2m}	[4]
T_{3m}	[4]
T_{4m}	[4]
T_{5m}	[5]
T_{20m}	[5]
T_{21m}	[5]
T_{30m}	[5]
T_{31m}	[5]
T_{32m}	[5]
T_{33m}	[5]
T_{34m}	[5]
T_{35m}	[5]
T_{36m}	[5]
T_{37m}	[5]
T_{38m}	[5]
T_{39m}	[5]

T_{40m}	[5]
T_{41m}	[5]
T_{42m}	[5]
T_{50m}	[5]
T_{51m}	[5]
T_{52m}	[5]
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T_{68m}	[5]
T_{69m}	[5]
T_{70m}	[5]
T_{71m}	[5]
T_{72m}	[5]
T_{73m}	[5]
T_{74m}	[5]
T_{75m}	[4]
T_{76m}	[4]
T_{77m}	[4]

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