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3RD GENERATION PARTNERSHIP PROJECT 2 "3GPP2"

cdma2000 Enhanced Packet Data Air Interface System

System Requirements Document

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REVISION HISTORY

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Version number	***Description***	***Date***
1.0	Initial publication text.	25 May 2006
2.0	Update to comply with OP direction regarding removal of CAPEX and OPEX references	17 May 2007

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1.0 INTRODUCTION

This document specifies the system requirements for the development of the cdma2000®[1] Enhanced Packet Data Air Interface (E-PDAI) system. E-PDAI is a part of cdma2000 evolution effort as indicated below:

- Phase 1: Multi-Carrier Support for HRPD (i.e., HRPD Rev. B)
- Phase 2: E-PDAI

Existing cdma2000 systems include HRPD Rev. A [1] and cdma2000 1x Rev. D ([2] through [7]) and their predecessors.

This document is intended to be used to guide the formal technical development of the E-PDAI air interface system and applicable IOS support.

2.0 REFERENCES

The references which are applicable to this specification include the following:

[1] 3GPP2 C.S0024-A, *"cdma2000 High Rate Packet Data Air Interface Specification,"* March 2004

[2] 3GPP2 C.S0001-D, *"Introduction to cdma2000 Spread Spectrum Systems Release D,"* February, 2004

[3] 3GPP2 C.S0002-D, *"Physical Layer Standard for cdma2000 Spread Spectrum Systems, Revision D,"* February, 2004

[4] 3GPP2 C.S0003-D, "*Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems, Release D,"* February, 2004

[5] 3GPP2 C.S0004-D, *"Signaling Link Access Control (LAC) Standard for cdma2000 Spread Spectrum Systems, Release D,"* February, 2004

[6] 3GPP2 C.S0005-D, *"Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems, Release D,"* February, 2004

[7] 3GPP2 C.S0006-D, *"Analog Signaling Standard for cdma2000 Spread Spectrum Systems, Release D,"* February, 2004

[1] cdma2000® is a 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 is a registered trademark of the Telecommunications Industry Association (TIA-USA) in the United States.

[8] 3GPP2 C.R1002, *"cdma2000 Evaluation Methodology,"* December 10, 2004 and its revisions

[9] 3GPP2 C.S0057, Version 1.0, *"Band Class Specification for cdma2000 Spread Spectrum Systems,"* February 9, 2004 and its revisions

[10] Recommendation ITU-R M.1034-1 Requirements for the Radio Interface(s) for International Mobile Telecommunications-2000 (IMT-2000)

3.0 DEFINITIONS AND ABBREVIATIONS

The terms and abbreviations which are used within this specification are defined as follows:

AN	Access Network
AT	Access Terminal
Backward compatibility	Support for the operation of a legacy (i.e., those based on previous HRPD standards) AT in accessing a system that supports a new technology (e.g., OFDMA, MIMO or SDMA) for both the forward and reverse links (i.e., FL/RL) of CDMA channels which includes either part or all of the radio spectrum designated for FL/RL CDMA channels for the new technology. In addition, an AT based on the new technology should be able to access service from a legacy AN.
E-PDAI	Enhanced Packet Data air interface
EUIM-ID	Expanded R-UIM Identifier
End-to-end QoS Management Support	Coordination of QoS throughout all network elements and the AT, including transport layer and air-interface (e.g., by means of scheduling and signaling).
FL	Forward Link

HSPA	UMTS technologies that include High Speed Downlink Packet Access (HSDPA) and High Speed Uplink Packet Access (HSUPA)
IOS	Interoperability Specification [3GPP2 Access Network Interface Interoperability Specification]
High speed vehicular environment	Up to 350 km/hour as described in [10]
MEID	Mobile Equipment Identifier
Pedestrian speed environment	Up to 10 km/hour as described in [10]
R-UIM	Removable User Identity Module
RL	Reverse Link
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile Telecommunications System.
VoIP	Voice over Internet Protocol.
W-CDMA	Wideband CDMA technology used in UMTS

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4.0 GENERAL DESCRIPTION

The E-PDAI system is intended to meet the following objectives when compared to existing cdma2000 technologies:

- Increase Voice Capacity using VoIP technology.
- Increase Peak Data Rates and System Capacity. (The proposed peak data rates as a long-term target ranged from 100 Mbps to 1 Gbps, depending on mobility, for the FL and up to 50 Mbps for the RL.)
- Support bandwidth allocations up to 20 MHz in 1.25 MHz blocks.
- Increase spectral efficiency.
- Decrease system latency.
- Improve cell coverage and increase range.
- Improve performance at cell edge within current cell geometries.
- Support flexible spectrum allocation options including possible operation on non-contiguous carriers.
- Support dynamic channel allocation.
- Minimize control and signaling overhead.
- Decrease terminal power consumption.
- Decrease cost-per-bit for CAPEX and OPEX.
- Support seamless handoff to other radio access technologies including VoIP to 1x circuit voice.
- Improve configuration and capacity management options for intra-user QoS
- Improve end user perception of radio link performance.

5.0 HIGH LEVEL SYSTEM REQUIREMENTS

The E-PDAI requirements are specified below.

5.1 Quantitative Performance Requirements

The E-PDAI system shall be capable of the following requirements to support anticipated features while maintaining the cdma2000 market lead.

Detailed assumptions and conditions associated with these requirements (including, but not limited to, channel propagation and fading models, data and voice application models, required reliability and delay) will be developed as a part of the TSG-C effort to validate these requirements.

5.1.1 Voice Capacity

REQUIREMENT	
Number of concurrent VoIP sessions per sector per MHz in a system fully loaded with only VoIP users.	100

5.1.2 FL Peak Data Rates

REQUIREMENT	
5.1.2.1 Peak (i.e., maximum instantaneous) data rates in 20 MHz bandwidth for a user when operating in a stationary indoor environment in a sparsely loaded system.	500 Mbps
5.1.2.2 Peak (i.e., maximum instantaneous) data rates in 20 MHz bandwidthfor a user when operating in a pedestrian speed environment in a sparsely loaded system.	250 Mbps
5.1.2.3 Peak (i.e., maximum instantaneous) data rates in 20 MHz bandwidth for a user when operating in an outdoor, high speed vehicular environment in a sparsely loaded system.	100 Mbps

5.1.2.4 The FL Peak Data Rates shall be scaleable with bandwidth in the range of bandwidth allocations specified in section 5.2.1. For example, the peak data rates in 5 MHz bandwidth shall be one fourth of what is specified in the above table.

5.1.3 RL Peak Data Rates

REQUIREMENT	
5.1.3.1 Peak (i.e., maximum instantaneous) data rates in 20 MHz bandwidth for a user when operating in a stationary indoor environment in a sparsely loaded system.	150 Mbps
5.1.3.2 Peak (i.e., maximum instantaneous) data rates in 20 MHz bandwidth for a user when operating in a pedestrian speed environment in a sparsely loaded system.	100 Mbps
5.1.3.3 Peak (i.e., maximum instantaneous) data rates in 20 MHz bandwidth for a user when operating in an outdoor, high speed vehicular environment in a sparsely loaded system.	50 Mbps

5.1.3.4 The RL Peak Data Rates shall be scaleable with bandwidth in the range of bandwidth allocations specified in section 5.2.1. For example, the peak data rates in 5 MHz bandwidth shall be one fourth of what is specified in the above table.

5.1.4 Sector Throughput

REQUIREMENT	FORWARD LINK	REVERSE LINK
System-wide average data rates in 20 MHz bandwidth when operating in a fully loaded system in an outdoor, high speed vehicular environment.	60 Mbps	30 Mbps

5.1.5 System Latency

REQUIREMENT	
5.1.5.1 IDLE STATE LATENCY: The time it takes for a device to go from an idle state (fully authenticated/registered and monitoring the control channel) to when it begins exchanging data with the network on a traffic channel or timeslot.	10 msec
5.1.5.2 TRANSMISSION LATENCY - Reverse Link: The one-way transit time between the start of an IP data packet transmission from the AT IP layer and its arrival at the AN IP layer for a high priority service assuming all radio resources have been previously assigned.	10 msec
5.1.5.3 TRANSMISSION LATENCY - Forward Link: The one-way transit time between the start of an IP data packet transmission from the AN IP layer and its arrival at the AT IP layer for a high priority service assuming all radio resources have been previously assigned.	10 msec
5.1.5.4 HANDOFF LATENCY – The time between the point when an AT breaks connection with its then current operating channel and when it makes connection with a target handoff channel.	20 msec

5.1.6 Cell Coverage

REQUIREMENT	
Percentage of ATs uniformly distributed in the system that can achieve a data rate of 9600 bps on both the forward and reverse links with the distribution of all other parameters (e.g., cell loading, path loss) as defined by the evaluation methodology team.	97%

5.2 Other Verifiable Operational Requirements

The E-PDAI system shall be capable of the following additional verifiable operational requirements:

5.2.1 Support channelization compatible with the C.S0057 Band Class specification [8]. In addition to the current cdma2000 channel bandwidth allocations, E-PDAI ATs operation in bandwidth allocations including guard bands of 2.5 MHz, 3.75 MHz, 5 MHz, 10 MHz, 15 MHz, and 20 MHz should be considered.

5.2.2 Support flexible spectrum allocation options including possible operation on non-contiguous carriers.

5.2.3 Support dynamic channel allocations.

5.2.4 Support the following requirements related to BS transmission range:

- Full compliance for all requirements herein for cell radii as detailed in C.R1002 cdma2000 Evaluation Methodology [7].
- The specification should not preclude maximum cell ranges of 100 km or more.

5.2.5 Support system RF design that will allow an E-PDAI system to meet or exceed all minimum desired performance requirements under the following co-existence scenarios:

- Co-existence in the same geographical area and co-location with other cdma2000 technologies on adjacent channels.
- Co-existence in the same geographical area and co-location between operators on adjacent channels.
- E-PDAI shall be possible to operate standalone (i.e. without the need for any other carrier to be available).
- Co-existence on overlapping and/or adjacent spectrum at country borders except that some degredation may be expected in this case.
- Co-existence in the same geographical area and co-location with W-CDMA/HSPA and its further evolving technologies on adjacent channels.
- Co-existence in the same geographical area and co-location with IEEE 802 wireless broadband and personal area network technologies (e.g., IEEE 802.16).

5.2.6 Support of user and terminal authentication including support for parameters stored on R-UIM, UICC, etc.

5.2.7 Support for system level encryption of message payloads with associated encryption key management support.

5.2.8 Support for inclusion of End-to-end QoS Management Support.

5.2.9 Support for international roaming.

5.2.10 Support for MEID and EUIM-ID

5.3 Seamless Interoperation with Other cdma2000 technologies

The E-PDAI system shall be capable of verifiable seamless interoperation with all cdma2000 technologies.

5.4 Seamless Inter-technology Handoff to Other Radio Access Technologies

The E-PDAI system shall be capable of verifiable seamless inter-technology handoff to other radio technologies by E-PDAI ATs based on multi-mode AT configurations where both technologies support the inter-technology handoff. The other radio technologies include but are not limited to the following:

- UMTS
- WLAN technologies including the IEEE 802.11 family
- Wireless broadband and personal area network technologies (e.g., IEEE 802.16)

5.5 System Design Attributes

This section defines the non-quantitative system design attributes that are required to support the operator requirements herein.

5.5.1 Minimize control and signaling overhead.

5.5.2 Decrease E-PDAI AT power consumption as compared to HRPD Rev. B AT power consumption.

5.5.3 Decrease system equipment complexity as compared to systems based on previous cdma2000 air interface as well as other air interface technologies.

5.5.4 Decrease system operational complexity as compared to systems based on previous cdma2000 air interface as well as other air interface technologies.

5.5.5 E-PDAI must be able to use existing cell sites and to meet all requirements using those cell sites. However, the specification development effort should also consider that the enhanced specifications of the new air interface will empower new system engineering strategies.

5.5.6 Backwards compatibility is highly desirable, but the trade off versus performance and/or capability enhancements should be carefully considered.

5.5.7 The E-PDAI system should be designed in a manner to minimize the impact on the existing or evolving core network.

5.5.8 The E-PDAI air interface shall be extensible so that technical innovations can be incorporated in the future to achieve peak FL data rates of 1 Gbps in 20 MHz bandwidth for a user when operating in a stationary indoor environment in a sparsely loaded system. For example, the E-PDAI design should not be restrictive with respect to potential improvements in antenna configuations.

5.5.9 The E-PDAI system should be designed to minimize the rate of dropped calls.