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3RD GENERATION
PARTNERSHIP
PROJECT 2
"3GPP2"

Support for End-to-End QoS

Stage 1 Requirements

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1 INTRODUCTION AND SCOPE

2 This document describes the requirements necessary to support E2E (End-to-
3 End) QoS in the cdma2000^{®1} wireless IP network. The requirements are based
4 on leveraging, and extending where applicable, the standard IETF protocols for
5 QoS. The proposed functionality described by these requirements include the
6 use of int-serv, diff-serv, int-serv to diff-serv inter-working, network policy and
7 subscriber profile, network provisioning and link layer to upper layer QoS
8 adaptation. This document also specifies the requirements for the cdma2000
9 Radio Link QoS.

12 REFERENCES

13 The document references, which are applicable to this specification,
14 include the following:

- 15 ▪ [1] *Not Used.*
- 16 ▪ [2] S.R0037 *IP Network Architecture Model for cdma2000 Spread*
17 *Spectrum Systems.*
- 18 ▪ [3] 3GPP TS 23.207 V5.5.0 (2001-02) *3G Partnership Project Technical*
19 *Specification Group Services and System Aspects; End to End QoS*
20 *Concept and Architecture.*
- 21 ▪ [4] 3GPP2 *Quality of Service JEM Report, S00-20010129-009, January*
22 *29, 2001.*
- 23 ▪ [5] 3GPP2 *Quality of Service JEM Output, S00-20010129-008, January*
24 *29, 2001.*
- 25 ▪ [6] Bernet Y., et al., “A Framework for Integrated Service Operation over
26 *Diffserv Networks*”, RFC2998, November 2000.
- 27 ▪ [7] 3GPP2 C.S0001 *Introduction to cdma2000 Spread Spectrum*
28 *Systems.*
- 29 ▪ [8] 3GPP2 C.S0002 *Physical Layer Standard for cdma2000 Spread*
30 *Spectrum Systems.*
- 31 ▪ [9] 3GPP2 C.S0003 *MAC Layer Standard for cdma2000 Spread*
32 *Spectrum Systems.*
- 33 ▪ [10] 3GPP2 C.S0004 *LAC Layer Standard for cdma2000 Spread*
34 *Spectrum Systems.*

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

- 1 ▪ [11] 3GPP2 C.S0005 Upper Layer Signaling Standard for cdma2000
- 2 Spread Spectrum Systems.
- 3 ▪ [12] 3GPP2 C.S0017 Data Service Options for cdma2000 Spread
- 4 Spread Spectrum Systems.
- 5 ▪ [13] 3GPP2 C.S0024-0 v4.0 cdma2000 High Rate Packet Data Air
- 6 Interface Specification, October 2002.
- 7 ▪ [14] 3GPP2 X.S0011-004 cdma2000 Wireless IP Network
- 8 Standard:Quality of Service and Header Reduction

12 **3 DEFINITIONS AND ABBREVIATIONS**

13 The terms and abbreviations, which are used within this specification,

14 are defined as follows:

BR	Border Router
CN	Correspondent Node. A peer with which a mobile station is communicating. A correspondent node may be either mobile or stationary.
E2E QoS	End-to-End Quality of Service
HA	Home Agent
HAAA	Home AAA
HDB	Home Data Base
MS	Mobile Station
PDF	Policy Decision Function
PDSN/AGW	Packet Data Serving Node/ Access Gateway
IETF	Internet Engineering Task Force
SLA	Service Level Agreement
VAAA	Visited AAA
VDB	Visited Data Base
P-CSCF	Proxy-Call Session Control Function
S-CSCF	Serving-Call Session Control Function
RAN	Radio Access Network

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Asymmetric Bearers: Bearers in opposite directions between the same two endpoints that have different QoS attributes.

Best Effort: The network does its best to forward IP packets but does not provide any guarantee on the delivery of the IP packets.

QoS Attribute: A QoS Attribute is one of several characteristics that can be assigned to a bearer. The QoS Attributes may include, but are not limited to:

- bandwidth
- delay
- jitter
- packet loss
- priority
- traffic class

The quality of a bearer can be described by the attributes given above.

QoS Negotiation: The QoS Negotiation is the process followed by a QoS requestor and a QoS service provider for ultimately agreeing or disagreeing on a QoS attribute or set of attributes.

Subscriber's QoS Profile: The set of values or range of values of the QoS attributes authorized for the subscriber. The authorized QoS attributes are part of the subscriber's AAA profile. The Subscriber's QoS profile contains limits on the resources that can be authorized for use by a subscriber. These limits may include maximum allowed bandwidth, minimum delay, minimum packet loss rate etc. and may contain default values greater than best effort when no specific QoS request is signalled.

Main service instance: A packet data service instance that is set up during the initial establishment of a packet data service. This packet data service instance normally has default QoS characteristics that are based on subscriber's AAA profile and local policy.

Auxiliary service instance: A packet data service instance that is set up on-demand to support a required QoS greater than the default QoS characteristics that are configured for the Main service instance. This packet data service instance has QoS characteristics that are based on the request of the user, limited by the subscriber's QoS profile and local policy.

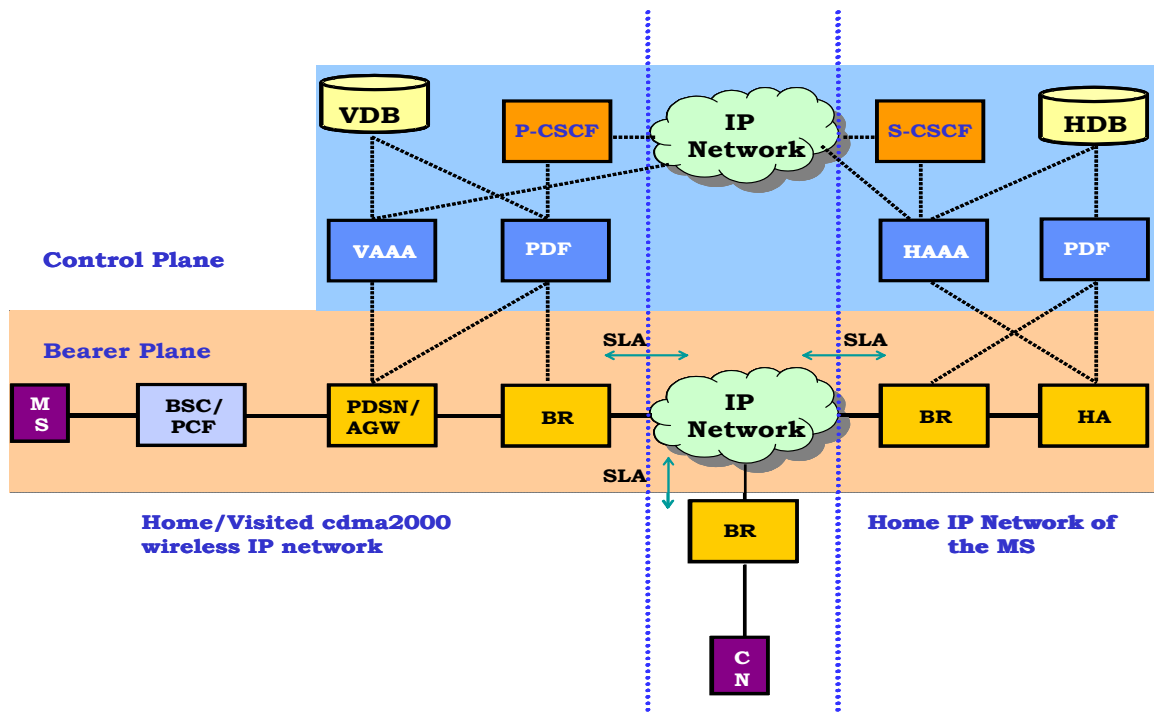
Differentiated-Services (diff-serv): A QoS architecture developed in the IETF that divides IP traffic into small number of classes and provides QoS to large aggregate of IP traffic.

1 **Integrated-Services (int-serv):** A QoS architecture developed in the IETF
 2 that uses signaling to establish E2E QoS for application flows.

3 **Traffic Classes.** Distinct QoS categories of application/service..
 4

5
 6 **4 GENERAL FEATURE DESCRIPTION**

7 Requirements are defined to enable a cdma2000 wireless IP network to
 8 provide E2E QoS between a mobile station and a correspondent node.
 9 The E2E QoS network reference model involves several IP nodes. The two
 10 end points are the MS and the correspondent node (CN). The intervening
 11 networks span across a cdma2000 wireless IP network that includes the
 12 radio link, the intermediate IP network, and the Edge IP network of the
 13 correspondent node. The E2E reference model can be viewed as a set of
 14 consecutive networks. Figure-1 depicts an example of the E2E QoS
 15 architecture. (Note: Figure 1 is for reference purposes only. It does not
 16 imply that all network elements shown are necessarily involved with E2E
 17 QoS.) E2E QoS may be provided by explicit management of QoS on the
 18 consecutive networks, or by provisioning, or a combination of both.
 19



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 33 **Figure 1. E2E QoS reference model**

34 The availability of E2E QoS functionality in the cdma2000 wireless IP
 35 network provides the following benefits:

- 1 • E2E QoS would enable users to launch a variety of applications
2 and experience their associated benefits in the wireless mobility
3 context.
- 4 • E2E QoS would enable cdma2000 wireless IP network providers to
5 provide a variety of services and benefit from their associated
6 revenue streams.

7 The following provides an example of an approach to E2E QoS in the
8 cdma2000 wireless IP network:

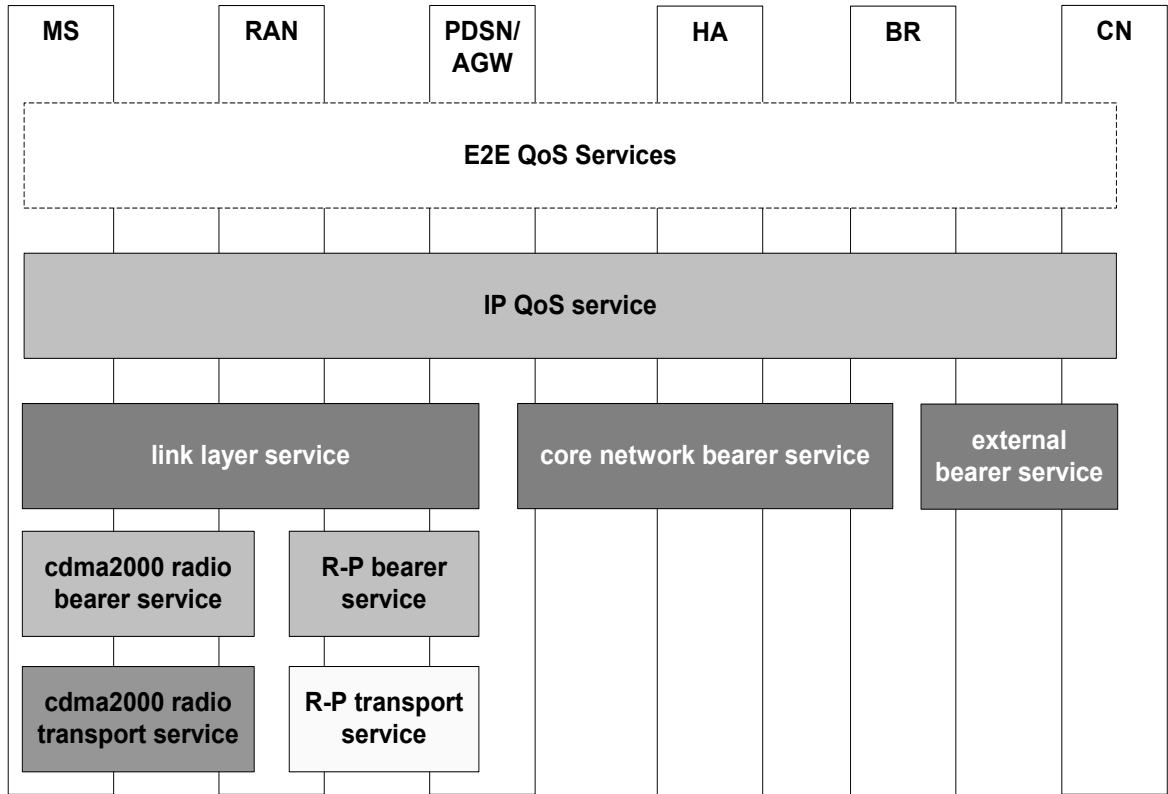
9 The E2E QoS support in the cdma2000 wireless IP network may be
10 provided via one or more instances of a packet data service. The types of
11 instances of a packet data service are identified as a main service
12 instance or an auxiliary service instance. In the cdma2000 wireless IP
13 network, the radio resources should be allocated per service instance.

14 In this context the purpose of a main service instance is used to provide
15 resources in the cdma2000 wireless IP network to meet the QoS
16 requirements for the applications that may only require Best-Effort QoS
17 support. However, to meet the QoS demands of applications that require
18 better than Best Effort QoS, an auxiliary service instance can be used.
19 The resource allocation for an auxiliary service instance is selective and
20 is based on a characterization of QoS requirements associated with an
21 application. One or more auxiliary service instances may be established
22 by the MS based on the number of applications in use for an MS each
23 requiring different QoS.

24 **4.1 The cdma2000 E2E QoS bearer services:**

25 The E2E QoS support in the cdma2000 wireless IP network attempts to
26 reserve the necessary resources to ensure that the requested QoS
27 requirements for a user's application are satisfied. If the necessary
28 resources are not available in the cdma2000 wireless IP network, an
29 attempt should be made to negotiate a lower QoS. The following figure
30 shows the different bearer services in a cdma2000 network to satisfy
31 subscriber's E2E QoS requests.

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Figure 2. E2E QoS architecture

4 **E2E QoS Service:** The application layer QoS between the end hosts
5 identifies the QoS requirements, for example via SIP/SDP signaling
6 protocol. The QoS requirements from application layer are mapped down
7 to create a network layer session. The mobile terminal then establishes a
8 link layer connection suitable for support of the network layer session.
9 The QoS parameters received from the application layer are mapped to
10 the corresponding IP layer signaling parameters as well as the link layer
11 parameters.

12

13 **IP QoS Service:** In the E2E scenario, the mobile terminal can use the IP
14 QoS service to control the QoS at the local and remote access networks,
15 and diff-serv to control the IP QoS through the backbone IP network. Any
16 IETF defined IP QoS signaling protocol can be used for different services.
17 The entities that are supporting the IP QoS signaling should act
18 according to the IETF specifications for int-serv and int-serv/diff-serv
19 interworking.

20 In addition to provision of E2E QoS Service and via IP QoS Service, QoS
21 requirements may also be determined based on operator local
22 policy/SLA.

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Link Layer Service: The Link layer service currently does not provide any QoS capability. Support for QoS at the PPP layer (or any other link layer protocol that might be used in the future) is FFS.

External Bearer Service: The bearer services provided by the external network. e.g., the IP core network that is not owned and operated by the wireless service providers.

cdma2000 Radio Bearer Service: cdma2000 radio bearer services and their associated QoS parameters are defined in [12], [13]. This includes both the assured mode and non-assured mode QoS parameters. This service is enabled by the cdma2000 radio transport service.

R-P Bearer service: The R-P bearer service is concerned with the QoS guarantee for the following service scenario:

The bearer resources are allocated on the R-P interface in an attempt to meet the QoS requirements received from the mobile user as allowed by the network.

Core network bearer service: The core network in the cdma2000 wireless IP network provides this type of bearer service between PDSN/AGW and BR.

cdma2000 Radio Transport Service: This service is provided by the cdma2000 physical layer that is categorized by the QoS classes and parameters based on the stringent requirements of the physical channels (FCH, DCCH, SCH, etc). Note that the MAC/Multiplex sublayer has to map the radio bearer QoS parameters (logical channel) onto the physical channel QoS parameters. The radio transport layer service is concerned with the physical radio channel payload data units produced and consumed by the cdma2000 radio bearer service plus any signaling associated with those radio channels, e.g., common channel signaling, and call control messages and OAM. The radio transport service QoS should not be dependent on the definition of the radio bearer service QoS, or any higher-layer QoS definitions.

1 **R-P Transport Service:** The service provided by the R-P transport
2 network to guarantee delivery of the R-P bearer services within their
3 specified QoS limits.

4 5 **5 DETAILED FUNCTIONALITY REQUIREMENTS**

6 **5.1 Detailed Feature Characteristics and Requirements**

7 **5.1.1 The Operational Requirements for the cdma2000 wireless IP** 8 **network to support E2E QoS.**

9 5.1.1.1 For QoS signaling, an open standard (IETF supported) E2E
10 QoS signaling protocol shall be used in the cdma2000
11 wireless IP network.

12 5.1.1.2 The cdma2000 wireless IP network shall allow the MS to
13 communicate with the Correspondent Node in order to
14 request the reservation of the necessary resources to meet the
15 E2E QoS required by an application. The cdma2000 wireless IP
16 network shall relay the E2E QoS signals to and from the MS
17 and the Correspondent Node.

18 5.1.1.3 If the necessary resources are not available, the cdma2000
19 wireless IP network shall have the ability to negotiate a
20 mutually acceptable E2E QoS with the Correspondent Node
21 and the MS. The MS's request for QoS resources may be
22 limited by the network provider's policy and the subscriber's
23 QoS profile.

24 5.1.1.4 The visited cdma2000 wireless IP network's policy for E2E
25 QoS shall have precedence over the subscriber's QoS profile
26 and may only further restrict the QoS values in the profile.

27 5.1.1.5 The home IP network provider's policy for E2E QoS shall apply
28 to any resource reservation in the home network.

29 5.1.1.6 The user's subscription profile for E2E QoS shall be stored in
30 the home network in the Home Data Base (HDB) and may be
31 cached in other network nodes.

32 5.1.1.7 A Service Level Agreement (SLA) should be established between
33 the cdma2000 wireless IP network and the peer networks. The
34 SLA shall be enforced at the Border Router (BR).

35 5.1.1.8 The policy and provisioning frameworks in the cdma2000
36 wireless IP network for E2E QoS should be based on IETF
37 protocols.

38 5.1.1.9 E2E QoS shall support the capability for information exchange
39 amongst network nodes for the purpose of resource allocation.

- 1 5.1.1.10 The cdma2000 wireless IP network bearer plane shall be able
2 to support multiple and simultaneous packet data services
3 (e.g., conversational, streaming, etc.) for users.
- 4 5.1.1.11 The granted E2E QoS values for a user's session shall be
5 included in the appropriate accounting records.
- 6 5.1.1.12 The E2E QoS solution shall support both signaling based and
7 local policy/SLA based QoS.
- 8 5.1.1.13 The E2E QoS solution shall provide support for applications
9 that require E2E QoS but do not include air interface-specific
10 information or procedures.
- 11 5.1.1.14 The state information stored during dormancy, for a service
12 instance shall include granted Radio Link QoS attribute
13 information.
- 14 5.1.1.15 E2E QoS of a particular class shall be authorized based on a
15 subscriber's AAA profile and service provider's local policy.
16 When the E2E QoS is no longer authorized, E2E QoS shall
17 default to "Best Effort" class.
- 18 5.1.1.16 The E2E QoS architecture shall allow seamless delivery of
19 negotiated QoS during handoff across cdma2000 air interface
20 technologies.
- 21 5.1.1.17 The cdma2000 Wireless IP Network shall allow QoS on a per
22 flow basis between the Mobile Station and the Correspondent
23 Node.
- 24

25 **5.1.2 The Operation Requirements for the cdma2000 radio link to**
26 **support E2E QoS**

- 27 5.1.2.1 Radio Link QoS shall be subject to radio network operator-
28 defined policies and subscriber's QoS profile in the AAA.
- 29 5.1.2.2 A request for Radio Link QoS attributes for a new service
30 instance or a request to modify the Radio Link QoS attributes
31 of an existing service instance shall be supported.
- 32 5.1.2.3 The cdma2000 Radio Link QoS shall be defined in terms of the
33 QoS Attributes.
- 34 5.1.2.4 The per subscriber Radio Link QoS authorization should be
35 performed based on subscriber's QoS profile in the AAA.
- 36 5.1.2.5 The Radio Link QoS mechanism shall support a mapping
37 between application requirements and cdma2000 Radio link
38 layer QoS attributes.

- 1 5.1.2.6 When a service instance transitions from the dormant state to
 2 the active state, the Radio Link QoS attributes of the prior
 3 service instance should be requested/granted at the pre-
 4 dormancy values, if possible. If the pre-dormancy Radio Link
 5 QoS attribute values can not be granted, newly negotiated
 6 Radio Link QoS attribute values shall be established.
- 7 5.1.2.7 Radio Link QoS shall support an asymmetric bearer (i.e. the
 8 ability to support different Radio Link QoS attributes values
 9 associated with the forward and reverse airlinks.
- 10 5.1.2.8 When establishing Radio Link QoS attribute values for service
 11 instances, the Radio Link QoS mechanism shall allow the
 12 specification of value ranges rather than single values for
 13 Radio Link QoS attributes to accommodate the unpredictable
 14 nature of the wireless link.
- 15 5.1.2.9 The granted cdma2000 airlink QoS values for a user's session
 16 shall be included in the appropriate accounting records.

17
 18 The system shall record call detail information as follows:

- 19 • the requested E2E QoS attributes
- 20 • the granted E2E QoS attributes
- 21 • the re-negotiated E2E QoS attributes, if applicable,
- 22 • the volume of data transferred and
- 23 • the duration of use.
- 24 • time of day of the start of the session

25
 26 5.1.2.10 QoS traffic classes shall be defined with respect to the other
 27 QoS Attributes. The following table lists examples of traffic
 28 classes:

Class	Attributes of Traffic
Conversational	Two-way, low delay, low data loss rate, sensitive to delay variations.
Streaming	Same as conversational, one-way, less sensitive to delay. May require high bandwidth.
Interactive	Two-way, bursty, variable bandwidth requirements moderate delay, moderate data loss rate correctable in part.
Background	Highly tolerant to delay and data

	loss rate has variable bandwidth.
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2 The service provider may also choose to specify the Per Hop
3 Behavior (PHB) according to the subscriber's QoS profile.
- 4 5.1.2.11 If the requested level of QoS or traffic class is unspecified by
5 the application or local policy/SLA, the system default level of
6 QoS or traffic class shall be used.
- 7 5.1.2.12 If the required resources for a requested level of QoS or traffic
8 class are not available, the system should attempt to
9 negotiate an alternative to the requested QoS.
- 10 5.1.2.13 The QoS mechanism shall support a wide range of services and
11 applications and allow the specification of traffic classes.
- 12 5.1.2.14 The Radio Link QoS information (both requested Radio Link
13 QoS attributes and granted Radio Link QoS attributes) shall
14 be included in accounting records
- 15 5.1.2.15 Consistent QoS shall be ensured among networks across an
16 intersystem handoff.
- 17 5.1.2.16 If the E2E QoS cannot be honored on intersystem handoff, the
18 QoS shall revert to local policy.
19