MOBILE
ISSUE OCTOBER 2003

RADIO NETWORK
(BASE STATION CONTROLLER & BASE TRANSCEIVER STATION)
OF
WLL SYSTEMS BASED ON CDMA2000 1X STANDARDS

GENERIC REQUIREMENTS
GR NO. GR/WLL-04/01.OCT2003

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Generic Requirements
for
Radio Network (BSC & BTS) of WLL Systems based on cdma2000 1x Standards

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GR NO. GR/WLL-04/01 OCT.2003

History Sheet

Sl. No.	Title	GR No.	Remarks
1	Radio Network (Base Station Controller & Base Transceiver Station) of WLL Systems based on cdma2000 1x Standards	GR/WLL-04/01OCT .2003	Issue 01

Table of contents

CHAPTER - 1

1. INTRODUCTION

1.1 This document contains the Generic Requirements (GR) of Radio Network consisting of Base Station Controller (BSC) and Base Transceiver Station (BTS), including Operations and Maintenance Centre (OMC) of a Digital Wireless Local Loop (WLL) system based on the cdma20001x standards (TIA/EIA/ IS-2000) to provide two way communication to customers of Bharat Sanchar Nigam Limited (BSNL)/ Mahanagar Telephone Nigam Limited (MTNL). The cdma2000 1x standards are based on TIA/EIA (Telecom Industry Association/Electronic Industry Association, USA) standards, 3GPP2 (Third Generation Partnership Project 2) standards and ITU-R Rec. No. M-1457.

The tendering authority, at the time of tendering should review the versions of all the documents mentioned in this GR and update them if necessary.

1.2 The requirements spelt out in this GR relate to the BSC and BTS of cdma2000 1x based Digital Wireless Local Loop System supporting Remote Stations (RS) such as Fixed Wireless Terminals (FWT) and Hand Held (mobile) Terminals to provide communication in the network between either wireless to wireless or wireless to landline subscribers and vice-versa. It also specifies the requirements of OMC for the BSC & BTS.

1.3 Applications of such a Digital Wireless Local Loop system could be in urban and rural area with fixed and mobile wireless terminals in zero mobility, limited mobility or full mobility environment (as and when permitted).

1.4 The definition of "limited mobility" in a limited mobility system shall be as specified by the Department of Telecommunications (D.O.T). At present the limited mobility is restricted to Short Distance Charging Area (SDCA). This definition may change from time to time, and it shall be possible to limit mobility in the system accordingly.

1.5 A generic model of a cdma 2000 1x based Wireless Local Loop System shall typically consist of

a) Radio Network (RN) consisting of Base Transceivers Stations (BTS) and Base Station Controllers (BSC)
b) MSC based Core Network (CN)
c) Packet Switched Core Network (PCN)
d) Remote Station (RS)
e) Operations and Maintenance Centre (OMC)

Block schematic of the network is placed at Annexure -I.

1.6 BSC shall support IOS ver. 4.0 or later (3GPP2 Access Network Interfaces Inter-Operability Specification-3GPP2 A.S0001). The Radio Network (RN) shall be connected to the MSC based Core Network through IOS interface.

1.7 The BSC shall support the interfaces required for the Packet Switched Core Network - which has been shown as a component of the generic model of cdma2000 1x WLL system in para 1.5 above.

1.8 The system shall be able to provide voice service using both 8 Kbps Enhanced Variable Rate Codec (EVRC) (EIA/TIA IS-127-2), (3GPP2 standard C.S0014-0-2) and 13 Kbps QCELP (IS 733) vocoder type. It may optionally support Selective Multirate Vocoders (SMV).

1.9 Dynamic allocation of vocoders in real time shall be supported. The vocoder type shall also be selectable through a software command. The vocoder bypass capability (also referred to as TFO-Tandem Free Operation) may optionally be supported.

1.10 The possibility for the cdma 2000 1x radio interface to be upgraded to support operations in an evolved GSM-MAP based Core network, at a future date, as per the standard TIA/EIA/IS-833 defining the MC-MAP mode of operation shall be indicated. The system shall also be capable of finally migrating to an all - IP based Core Network.

1.11 It shall also be possible to upgrade the system to support cdma2000 1x Ev-DO. Hardware & Software changes required in BSC & BTS for upgradation to cdma2000 1x Ev-DO may be indicated. Capability to support cdma 2000 1x Ev DV systems in future may be indicated.

1.12 It shall be fully backward compatible with the existing cdmaOne networks, thereby implying that any cdma 2000 1x Remote Station would be able to place and receive calls in IS-95A/B systems. Conversely, any cdma 2000 1x system would be able to place and receive calls for IS-95A/B Remote Stations.

1.13 The System shall operate in the frequency band 824-844 MHz paired with 869-889 MHz or any other frequency band (as per 3GPP2) specified by the tendering authority. Possibility of operating in other spectrum bands (with radio upgrades only) may be indicated.

1.14 The system may optionally allow voice (or circuit data service) and packet data service to operate concurrently (within the limits of the air interface system capacity).

1.15 The system shall optionally support a Quality of Service (Q.O.S) control mechanism to balance the varying Q.O.S. requirements of multiple concurrent services.

1.16 The system shall be required to provide a wide range of voice and non-voice, circuit-switched and packet - switched services.

1.17 The system shall have the capability to support all the registration methods specified in the IS 2000 standards. The tendering authority, at the time of tendering, should specify the registration methods required to be supported in the equipment.

1.18 Pooling of resources such as channel elements, Linear Power Amplifier (LPA), Vocoders, Echo cancellers shall be available.

1.19 The architecture of the cdma 2000 1x system in terms of different layers for specific functions shall conform to the latest version of the following 3GPP2 standards: -

-	Physical layer	-	C.S0002
-	Link layer-MAC sub-layer	-	C.S0003
	LAC sub-layer	-	C.S0004
-	Upper layers	-	C.S0005

1.20 It shall be possible to integrate the system with the National Internet Backbone as defined in TEC GR No. G/NIB.01 (latest version) through PDSN.

1.21 IP based back haul between BTS and BSC , BSC and BSC shall be highly desirable. In case of non IP based back haul such as ATM, possibility of migrating to IP shall be indicated.

1.22 Possibility to upgrade the system to support IPv6 protocol in future shall be indicated.

1.23 The following paras describe the various components (under purview of this GR) of the generic model of the cdma 2000 1x based Wireless Local Loop System as defined in Para 1.5 above.

(i) **Base Transceiver Station (BTS**) is a multiple circuit transceiver which shall radiate to cover a cell or a sector. It consists of radio modules, base band signal processor, network interface, antenna, feeder etc. It can be co-located with BSC or remotely located. BTS shall include the functions related to channel coding/decoding, interleaving, encryption, frame building, modulation/demodulation, RF transceiver, antenna diversity, low noise amplification etc. as per cdma 2000 1x standards. The BTS obtains the timing reference and positioning reference from the GPS system and hence the GPS receiver shall form an integral part of the BTS along with other fixtures such as GPS antenna, cable etc. BTS split mounting arrangements with tower mountable RF components such as PAs, LNAs, Filters etc. are also acceptable. BTS shall be connected to BSC through interface as specified in clause No. 6.3.

Recommended Minimum performance of BTS is as per 3GPP2 standard No.C.S0010.

(ii) **Base Station Controller (BSC)** is responsible for inter - connection between the BTS and the Switching Centre and it provides control and management for one or more BTSs. It assigns traffic channels to individual users, monitors system performance and provides interface between the BTS and the Switching Centre. BSC performs the radio processing functions such as management of the radio resources, radio channel management, local connection management etc. It also processes information required for decision on handover of calls from one BTS to another. BSC can be either co-located with the MSC or located at a different location connected to the MSC through interface as specified in clause No 6.2 of Chapter 6, titled “Interfaces”.

The Packet Control Function (PCF) shall form an integral part of BSC and the connectivity shall be provided to the Packet Switched Core Network through interface as specified in clause No. 6.5 for delivery of high speed data services. The BSC, through

the Packet Control Function shall provide support for packet accounting/charging function for the radio specific parameters.

Value of Protocol Revision (P_REV), supported by the system shall be at least 6.

(iii) **Operations and Maintenance Centre (OMC) -** The OMC allows the centralized operation of the various units in the system and the functions needed to maintain the sub systems. The OMC provides the dynamic monitoring and controlling of the network management functions for operation and maintenance. The OMC shall support Graphical User Interface (GUI) for operation and standard TMN interfaces as specified in ITU-T Rec. M-3010 & M-3020.

The overall objective of OMC is that neither equipment failure nor human error in the OMC implementation should render the OMC and /or the part of the network it supervises, out of service.

The Operation & Maintenance Centre (OMC) shall be capable of performing the following functions: -

(i) Event/Alarm Management: Alarms should be presented to the operator via software programs and tools for easy presentation and interpretation, for easy maintenance and to locate faults of all managed elements of the network. Events are logged for future use.

(ii) Configuration Management : OMC shall provide real time configuration database access to manage the software loading and version tracking, support for addition, deletion and change of network element parameters.

(iii) Performance Management: OMC shall provide tools for the collection of statistics and call information into a database and logging file. Data shall be viewed using tabular or graphical reports on the GUI terminal.

(iv) Security Management : OMC shall provide password and login access to the system to prevent any unauthorized access to the system.

(v) Fault Management : OMC shall provide capability to query and change device states and provide control for system diagnostics.

(vi) Network statistics – OMC shall provide data related to channel occupancy, rejected calls etc. with visual display of faulty elements of the network.

OMC shall be a carrier grade system with full redundancy and scalability. It shall be possible to have remote workstations with the OMC, with complete GUI tools for O & M of the BSC/BTS at the remote locations. It shall support north-bound interface like Corba, TCP / IP, CMIP etc., to enable it to work with a remote NMS.

1.24 The RN shall provide smooth bearer for the features and services supported by the MSC & PDSN, to which this radio network shall be connected, from end-to-end perspective. The radio network shall not become a bottleneck for the functionalities that are to be offered by the MSC & PDSN.

1.25 For all TEC and other Standards documents referred in this GR, only the latest version shall be applicable.

CHAPTER-2

2. GENERAL REQUIREMENTS

2.1 Link Calculations - Detailed Link calculations (based on scattered transmission for 90% Cell Edge Reliability and 96% Area Coverage) for meeting the required coverage shall be provided by the equipment supplier taking into account the interference/ fading that is likely to be encountered by the system. However the actual link calculations would be based on actual RF survey and planning conducted prior to system planning for each site. Based on the RF survey & planning, the sector wise coverage maps and detailed budget link calculations shall be provided for both the forward link and the reverse link.

Some of the typical parameters to be assumed for detailed link calculations are as follows:

- Antenna height at BTS : 40 M
- Antenna height at wireless terminals
  - (i) for fixed wireless terminal : 4 meters
  - (ii) for hand held subscriber terminal : 1.3 meters
- Feeder Cable Loss : 3 dB
- Building penetration loss
  - a. Dense Urban : 26 dB
  - b. Urban : 20 dB
  - c. Sub-urban : 16 dB
  - d. Rural : 12 dB
- Value of Eb/No (Voice) : 4.2 dB
  (Data at 76.8 kbps) : 2.5 dB
- Value of Ec/Io (Voice) : -12 dB
  (Data) : - 8 dB
- Body Loss (For Hand Held) : 3 dB
- Vehicle Loss (For Hand Held) : 7 dB
- Soft Hand Off Gain : 3 dB
- Frame Error Rate (FER) for Voice : 1%
  For Data : 5%
- Formula used: HATA or equivalent applicable formula.

2.2 Standards Compliant & Multi-Vendor Support - System shall be based on cdma 2000 1x standard and other standards mentioned therein and shall be able to work in multi-vendors environment.

2.3 Spectral Efficiency - Equipment shall have high spectral efficiency. Detailed calculation of spectral efficiency shall be provided by the equipment supplier.

2.4 Dimensioning – The equipment supplier shall provide engineering rules/guidelines for dimensioning the capacity of the network components.

2.5 System shall support the following types of Remote Station (RS):

A. Fixed Wireless Terminals (FWT) - Supporting voice, Group 3 FAX, Subscriber's Call Charge Meter (Home Meter), voice band data up to 14.4 kbps and 144 Kbps data in packet mode. It shall also be possible to support IS-95A FWTs (as per TEC specification GR/TML-01).

B. Hand held subscriber terminal – cdma 2000 1x Hand held subscriber terminal supporting voice, voice band data up to 14.4 kbps in circuit mode and 144 kbps packet mode data. It shall also be possible to support IS 95 A Hand held subscriber terminals (as per TEC specification GR/TML-01).

2.6 Field Proveness - The equipment shall be fully solid state, field proven and shall adopt latest state-of-art technology. The equipment should have been field deployed commercially across multiple countries and network & for a reasonable period of time. Tendering authority may indicate the deployment & period of time for ensuring filed proveness.

2.7 Dimensions and Weight - Dimension and weight of each of the equipment shall be indicated by the equipment supplier.

2.8 Ease of Expansion - Expansion techniques of the equipment shall be easy, economical and shall not interrupt a working system. Expansion shall be required when the number of subscribers (capacity) in the area is increased or when the geographical coverage is increased. The equipment shall be modular in construction permitting expansion, without any major hardware changes by simply adding shelves and modules.

2.9 Power Consumption - The equipment shall have low power consumption and capable of indoor & outdoor operation. Equipment supplier shall specify the power requirement of the BTS for various configurations e.g. 1 Carrier 3 Sector (1C3S), 2C3S, 3C3S, 4C3S, in order to engineer suitable and optimum power infra-structure.

2.10 Hot-Swappable – All main control & processing modules including channel cards shall be hot- swappable.

2.11 Dimensions/ Mounting of BSC/BTS - BSC and BTS equipment shall each be of self supported cabinet or rack type. Maximum height of rack shall be restricted to 2100mm. To have greater flexibility for operations, front-only serviceable racks are preferred.. The outdoor BTS equipment shall be self - supported weather proof cabinet and capable of mounting on suitable structure. Actual dimension and weight shall be indicated by the equipment supplier. Accessories for mounting equipment, Antenna and feeder cable (if required) shall be specified & supplied along with the equipment.

2.12 Power Supply - The power supply unit shall form an integral part of the equipment and shall have protection against input over-voltage, short circuit, input reverse polarity protection & shall have visual indication for input under voltage.

2.13 Software:

(i) Software commands shall be user friendly menu-driven. The software shall be modular in architecture. Complete software for the equipment operation and maintenance including Operation & Maintenance Centre (OMC) shall be provided. The architecture of the software shall be open ended so that the growth can be handled in practice without any need of redesign of the software. The software supporting documentation shall be in English. Any update in the software at a later stage to overcome deficiencies of the system due to bugs, compatibility etc., shall be provided free of cost by the equipment supplier.

(ii) The equipment supplier shall undertake to supply on continuing basis all software updates. These updates shall include new features and services and other maintenance updates. The software up-gradation shall be possible with minimum interruption to the service.

(iii) The equipment supplier shall provide any software modification necessary due to modification of software in the inter-working with other networks such as PSTN/ISDN/PSPDN etc.

(iv) The system hardware/software shall not pose any problem due to changes in date and time caused by events such as changeover of millennium/century, leap year etc, in the normal functioning of the system.

2.14 Mobility Functions – It shall be possible to restrict the services of the subscriber within the sector, within the BTS, within a Group of BTSs, within BSC area, within a group of BSCs in a SDCA or any other area specified by BSNL/MTNL under the definition of "limited mobility" as specified by DOT (Refer clause 1.3 of this document) from time to time.

2.15 Requirements of Outdoor Equipment - All outdoor equipment must be housed in robust, compact light weight weather proof cabinets and capable of mounting on suitable structure. The antenna cable shall extend out of the cabinet and be terminated externally in N-type or DIN type connectors. Suitable lightning protection shall be provided at the antenna ports. It shall be possible to install the BTS without opening the cabinet. The cabinets shall have a locking facility with a single master key for opening it.

2.16 Cooling Arrangement - The equipment shall have necessary self cooling arrangement with or without in-built fan. The fan, if used, shall be a D.C. fan and shall be used in redundant configuration. The MTBF of the fan shall be at least 80,000 hours. It shall have a provision to report the fan failure event to the OMC.

2.17 Diagnostics/Testing – The equipment shall support diagnostic capabilities (which will run as background tasks) to verify the equipment's proper operation within the network. Built-in test capabilities shall be provided which will run at specific events or on demand. Health monitoring signals shall be continuously passed between the various modules to ensure the detection of any failure in a module. Individual channel element functionality shall be also be monitored to prevent call blocking due to a lack of channel element resources. Markov

call testing shall be supported to verify local coverage and channel element Frame Error Rates (FER).

2.18 **Scalability** – Indoor BTS shall be compact and scalable for supporting up to 4 RF carriers with 3 sectors per carrier and outdoor BTS shall support up to 2 RF carriers with three sectors.

2.19 **Micro/ Macro Cell** – BTSs may be required for both Macro Cell applications as well as Micro Cell applications. The output power of the BTS shall be modifiable to configure the BTS as micro or pico BTS depending on the capacity/ coverage needs.

2.20 **Safety Requirements :**

a. The operating personnel shall be protected against shock hazards as per IS 8473 (1993) – Guide on the effects of current passing through the human body (equivalent to IEC publications 479-1 (1984).
b. The equipment shall conform to IS 13252 (1992) – Safety of information technology equipment including electrical business equipment (equivalent to IEC publication 95 (1986) and IEC 215 (1987) Safety requirements of radio transmitting equipments (for Radio equipments only)

The manufacturer/supplier shall submit a certificate in respect of compliance to these requirements.

CHAPTER -3

3. QUALITY REQUIREMENTS

3.1 Components

(a) All the components used shall have to be approved and qualified as per procedure specified in QA BSNL document no. QM-324. The source of procurement of components shall also have to be submitted by the manufacturers. Alternatively, the bidders may indicate whether the components are approved by any international authority.
(b) List of all the components for which second source is not available, shall be provided.

3.2 Quality Standards

(a) The equipment shall be manufactured in accordance with the International Quality Standard ISO-9001:2000 for which the manufacturer shall be duly accredited. Alternatively the product design/ manufacture shall conform to the international/ national quality standards. A quality manual describing the quality of the system to be followed during bulk manufacturing of the product would be required to be submitted by the manufacturer. The quality plan describing the quality assurance system followed by the manufacturer shall be submitted.
(b) The workmanship standards relating to PCB assembly/ components mounting shall be in conformance with QA guidelines in document No.QM205, QM-206 for through hole mounting and No.QM-210 for surface mounting technology.
(c) The product shall conform to the QA requirements stipulated in QM-301 (QA Requirement for transmission equipment) and QM-351 (QA Requirement for Switching equipment).

3.3 Lightning Protection - The equipment including Antenna & feeder, shall have adequate protection against lightning & power surges. All equipment shall have provision for grounding.

3.4 Markings

(a) The plug-in units - whose removal or insertion (while the equipment is in operation) might endanger the reliability or performance of the equipment -shall have suitable protection and caution marking.
(b) Each sub-assembly shall be clearly marked to show its functions and circuit reference so that its complete description can be located in the handbook.
(c) The components shall be marked with their schematic references so that they are identifiable from the component layout diagram in the handbook.
(d) All controls, switches, indicators etc. shall be clearly marked to show their circuit designations and functions.
(e) Each terminal block and terminal shall be marked with an identifying code.

3.5 Redundancy - The control equipment as well as Power Supply shall be provided with

1+1 hot standby / N+1 mode redundancy, in case of BSC, BTS & OMC. Any other redundancy provided shall be indicated by the equipment supplier. Redundancy of links between BTS-BSC and GPS receiver (along with other fixtures) if required, shall be indicated by the tendering authority at the time of tendering.

3.6 Quality of Service

(a) **Speech Quality** – As per 3GPP2 standard C.S0012 (TIA/EIA/IS 125) (Recommended Minimum Performance Standard for Digital Cellular Wideband Spectrum Speech Service Option 1)

(b) **Speech Delay** – As per ITU-T Rec G.173.

(c) **Freedom from Echo** – As per ITU-T G.165.

(d) **Voice Band Data Requirements**

- DTMF Signaling as per ITU-T Rec. G.174
- Data as per TIA/EIA/IS-707 (Data Service Options for Spread Spectrum System)
- Connection Performance as per ITU-T Rec. E.770
- Reliability Performance as per ITU-T Rec. E.800

e) **Packet Data Service –**A quality of service (QoS) control mechanism may be optionally supported, as per 3GPP2 document P.S0001.

3.7 Design Objectives - The design objectives with regard to Quality of Service shall be as follows:

(i) Time to connect call (RS originated – RS connection part)	: 6 sec max.
(ii) Time to confirm instruction to connect	: 1 sec max.
(iii) Time to release call (RS originated – RS connection part)	: 2 sec max.
(iv) Time to invoke or change a supplementary service	: 10 sec max.

3.8 Radio Resource Management – As part of the Radio Resource Management functions, the system shall support the following :

a) Call admission control algorithm that would permit dynamic allocation of system resources between voice and data users. It shall also be possible to pre-set desired thresholds for resource-allocation in terms of percentile of resources to be used by voice and data applications.

b) Radio Congestion control algorithm that would monitor the availability of resources and take corrective action when a transition from the normal state to the congested state is detected, to avoid drifting into the overload state.

c) Load balancing across FAs.

CHAPTER-4

4. OPERATIONAL REQUIREMENTS

4.1 Billing/Charging

For the packet data service, the PCF (an integral part of BSC) shall provide support for packet accounting/charging function for the radio specific parameters (usage time) and PDSN (not within scope of this GR), shall provide support for packet accounting/charging function for the IP network specific parameters (packet accounting).

4.2 **Modularity** - The BTS shall have the capability of being modularly equipped with suitable configurations on multiple sectors at single location.

4.3 **Frequency Tuning** : Frequency tuning shall be possible in the BTS through Man-Machine command.

4.4 It shall support Quick Paging Channel as defined by IS-2000 standards to reduce "Wake-up" time required by mobile terminals.

4.5 **Hand-off Types**- Hard handoff, Soft handoff, Softer handoff, Inter-BSC handoff and Inter-MSC (not within scope of this GR), Inter-PDSN hand off (not within scope of this GR) shall be supported. The action of switching a call in progress i.e. hand-off from one sector to another sector of same or adjacent BTS operating on same channel number or different channel number of same or different BSCs shall be automatic and smooth without the user noticing it. Continuous control of call quality shall be maintained automatically to get the optimum transmission quality.

4.6 **Power Control –** The equipment shall power control between RS and BTS automatically to get the optimum transmission quality. It shall support the following power control capabilities specified in IS-2000

- Enhanced Reverse Link Open Loop Power Control
- Reverse Link Closed Loop Power Control, Inner Loop and Outer Loop
- Forward Link Open Loop Power Control
- Forward Link Closed Loop Power Control

All modes of forward Power Control as defined in the standards shall be supported.

Reverse Link Power Control step size shall be configurable by the base station.

4.7 **Supervision** – Supervision of complete network shall be both automatic and operator controlled and centralized at OMC.

4.8 **Alarm Indications** –In case of all major alarms (any event that leads to system switch-over or service disruption) at the BSC, both audio and visual alarm indications shall be provided. In case of minor alarms at BSC and all alarms at BTS, visual alarm indications shall be

provided and provision of audio alarms is desirable. It shall be possible to define the major and minor alarm conditions and set the threshold values thereof. The OMC shall provide the flexibility to forward the alarm triggered by faulty operations to either a pager, a short message service system, an electronic mail or additional alarm windows on the OMC interface. It shall also be possible to extend the alarms at the BTS as well as external alarms to the BSC. The operator shall be able to redefine and configure the alarm forwarding destination. Facility shall exist for audio/visual alarm indication in the event of 'Route Busy', poor network performance in terms of under utilisation of BTS or too many blocked calls etc., or when the processor load exceeds a certain preset value. Alarm indication shall exist in the event of fan failure.

4.9 **Antenna configuration :** Antenna configuration at BTS shall be indicated by the equipment supplier.

4.10 **Synchronization -** All BTS / BSC digital transmission of the RN are referenced to a common CDMA system-wide Global Positioning System (GPS) time scale which is traceable to and synchronous with Universal Co-ordinated Time (UCT).

Thus BSC shall have the provision of deriving the timing signal from the following :

a) Internal Clock
b) Recovered Clock from any incoming 2048 Kbps signal.

In case of failure of recovered clock, the equipment shall support "Hold Over Mode", the stability of which shall be equal to or better than 1x10E- 8 for at least 24 hours.

4.11 **Security** - Authentication and encryption including extended encryption of signaling information, user data and voice privacy shall be as per 3GPP2 standard for Upper Layer C.S0005.

4.12 There shall be single directory number for voice, FAX, circuit switched data & packet data functions.

4.13 Maintenance Aspects:

It shall be possible to isolate Interface points for testing purposes.

Maintenance philosophy is to replace faulty units after quick analysis of monitoring and alarm indications. Actual repair will be undertaken at a repair centre.

Procedure for repair of equipment giving full details of testing instruments shall be provided by the equipment supplier. Test jigs, fixtures required for maintenance/repair shall also be provided. The supplier shall ensure the repair of faulty equipment during and after warranty period.

The equipment shall have easy access for servicing and maintenance. All important switches/controls on front panel shall be provided with suitable safeguards such as interlock system to avoid accidental operation by the maintenance personnel.

Extensive facilities for testing, supervision and monitoring functions shall be provided for quick isolation and rectification of faults. These functions shall be performed by Operations and Maintenance Centre (OMC) . Any additional instruments required shall be provided by the equipment supplier with details. The capabilities such as alarm reporting, automatic operation test shall be provided .

4.14 Documentation:

This describes the general requirements to be met by documentation to be provided by the equipment supplier. Hard & Soft copy of all documents shall be provided in English.

The documents shall comprise of

(i) System description documents
(ii) System operating documents including system repair document.

(i) System Description Documents

The following system description documents shall be supplied along with the system:

(a) Overall system specification and description of hardware and software.
(b) Installation manuals and testing procedures. Installation manuals to be provided for shall contain step by step process of installation of system.
(c) Equipment layout drawings
(d) Cabling and wiring diagrams
(e) Detailed specification and description of all I/O devices.
(f) Adjustment procedures, if there are any field adjustable units.
(g) Spare parts catalog including information on individual component values, tolerances etc. enabling procurement from alternate sources.
(h) Detailed description of software describing the principles, functions, interactions with hardware, structure of the program and data.
(i) Programming language (s) manual.
(j) Planning and system engineering documents.

(ii) System Operation Documents

The following system operation documents shall be provided by the equipment supplier :

a) Operating manual of the system
b) Maintenance manual.
c) Man-machine language manual.
d) Operation and maintenance manual for all I/O devices and auxiliary equipments.
e) Faulty location and trouble shooting instructions including fault dictionary.
f) Test procedures with auxiliary test equipments.
g) Emergency action procedures and alarm dictionary.

4.15 Power Supply

4.15.1 Input supply

i) **Base Station Controller (BSC) and Operations & Maintenance Centre (OMC)** : The system shall work satisfactorily for nominal input supply of -48 V DC over the voltage range of –44.4 V to –56.4 V.

ii) **Base Transceiver Station (BTS) :** The BTS shall operate on either of the following power supply. The tendering authority shall indicate the type of power supply on which the equipment shall operate.

a) Nominal input supply of -48 V DC over the voltage range of –44.4 V to –56.4 V

or

b) Nominal input supply of 230 VAC over voltage ranges of 90-270 V and frequency range of 50 Hz $\pm$ 2Hz.

4.15.2 Power consumption: The power consumption of system shall be specified by equipment supplier.

4.15.3 Protection : The protection for Input Over voltage, under voltage, and , short circuit protection shall be provided.

4.16 Antenna

The type & gain of BTS antenna may be decided by the equipment supplier out of the different types of antenna listed in the TEC GR No. GR/ANT-20 for getting desired coverage and performance of the equipment subsequent to detailed RF survey and planning.

Detailed specifications (technical as well as mechanical) shall be furnished by the equipment supplier. The antenna for the BTS shall be type approved by TEC against the TEC specifications GR/ANT-20.

4.17 Feeder Cable : Type of feeder cable (if applicable) and the length of the cable may be decided by the equipment supplier out of the different types of feeder cables listed in the TEC GR No. GR/AFDR-12 for getting desired coverage and performance of the system.

Detailed specifications (technical as well as mechanical) shall be furnished by equipment supplier. The feeder cables (in case of RF cables) shall be type approved by TEC against the TEC specification GR No. GR/FDR-12.

4.18 Electromagnetic Interference

Electromagnetic Compatibility (EMC): The equipment shall conform to the EMC requirements as per TEC Standard No. S/EMI-02 with the following standard limits indicated therein:

a) Conducted and radiated emissions:- To comply with Class B (Class B for low capacity (below 34 Mbps data rate) of CISPR 22 (2000)" Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment". BSC, OMC & Indoor BTS shall be as per Class A.
b) Fast transients common mode (burst):- To comply with IEC 61000-4-4 "Testing and measurement techniques of electrical fast transients/burst immunity test" under Level 2 (1KV for dc power lines; l kV for signal control lines).
c) Immunity: IEC 61000-4-3 "Radiated RF electromagnetic field immunity test" under Test level 2 (Test field strength of 3 V/m).
d) Surges common and differential mode :- to comply with IEC 61000-4-5 "Test & Measurement techniques for Surge immunity tests" under test levels of 0.5kV for differential mode and 1 kV for common mode.
e) Radio frequency common mode: To comply with IEC 61000-4-6 "Basic Immunity standard" under the test level 2 (3V RMS).

Note : For tests for checking compliance to above EMC requirements, the method of measurement shall be in accordance with TEC standard S/EMI-02 and the references mentioned therein.

4.19 Environmental Specifications:

(a) Base Transceiver Station : QM-333, Category B1 for indoor application and Category D for outdoor application (including bump, vibration, salinity & dust tests).

(b) Base Station Controller : QM-333 Category A

4.20 Transportation & Storage : As per QM-333.

4.21 MTBF/MTTR : The MTBF and MTTR (predicted and observed values) figures shall be worked out by the equipment supplier as per QA document QM-115 and based on these figures, the maintenance spares for three years shall have to be specified by equipment supplier. The availability figures shall be 99.999% for BSC and 99.9% for BTS.

4.22 Interference to existing wireless networks : The system shall not cause any interference to the existing wireless networks (GSM, CDMA or any other wireless system). Details of provisions made by the supplier to comply the clause, shall be indicated.

CHAPTER -5

5. TECHNICAL REQUIREMENTS

5.1 General

a.	Frequency band (800 MHz)	824-844 MHz paired with 869-889 MHz,
b.	Channel centre frequencies	As per TIA/EIA/IS-2000
c.	Channel Spacing	1.25 MHz
d.	Tx-Rx separation	45 MHz
e.	No. of R.F. carriers per BTS (i) indoor (ii) outdoor	Up to 4 with 3 sectors Up to 2 with 3 sectors
f.	Air Interface	TIA/EIA IS - 2000
g.	Access channel per carrier (to meet desired performance)	To be furnished by equipment supplier with details of traffic channel, control channel, paging channel etc.
h.	Frame Structure	As per TIA/EIA/IS-2000
I	Duplexing method	Frequency Division Duplexing (FDD)
j.	Voice Coding	8 Kbps Enhanced Variable Rate Vocoder (EVRC) as per IS127-2 standard, 13.4 Kbps QCELP vocoder as per IS-733
k.	Transmission bit rate	As per TIA/EIA/IS-2000
l.	Modulation scheme	As per TIA/EIA/IS-2000
m.	Demodulation scheme	As per TIA/EIA/IS-2000
n.	Backward compatibility	IS 95 A
o.	Local Oscillators	Synthesized, frequency shall be settable in steps to achieve desired frequency.
p.	Coverage without any Performance degradation	The coverage for voice as well as data (for various speeds up to 144 kbps) shall be as per the link calculations and shall be shown at the time of validation subject to Tx Power of BTS as ≤ 43 dBm and Receiver Sensitivity of BTS better than -123 dBm. However, actual coverage shall be based on prior RF Planning & Design Survey (Refer Clause 7.7). While assessing the coverage of the systems, shadow regions shall be supported by predicted coverage maps. Tendering authority may indicate whether repeaters are required to be provided for coverage to the shadow regions/dark spots. The capabilities of the systems shall be supported by link calculations using Hata or any other applicable formula as per clause 2.1.

q.	**System capacity**	**I. Minimum capacity of BSC** : i) 3000 Erlang with 200K BHCA which corresponds to approx. 33,000 lines assuming a call model of 0.09 Erlang/subscriber,6 BHCA/subscriber & 1% GOS at air interface. ii) **Scalability** : It shall be possible to dimension the system from 5,000 lines and expand in steps of 2,000 lines to the required capacity. iii)The terminating capacity of one BSC shall be able to support at least 150 BTSs of 1FA/3S. iv)Assuming GOS of 0.5%, total terminating capacity for E1 links towards BTS, MSC and PDSN shall be indicated by the vendor. Restriction, if any, in configuring the E1s to a specific direction (towards BTS/MSC/PDSN), may be indicated. **II. Capacity of BTS –** For FER of 1%, GOS of 1% & voice only application, assuming 100% terminals of cdma2000 1x and calculations based on Forward Link (BTS-RS), the capacity shall be as follows - i. 100% Mobile Environment - 75 Erlang/FA corresponding to approx. 35 simultaneous users/FA/Sector for 3 sector configuration assuming minimum links/user as 1.8. ii. 100% Fixed Environment - 110 Erlang/FA corresponding to approx. 45 simultaneous users/FA/sector.
r.	Traffic capacity (Erlang/sector/MHz for 1% GOS a) With voice only service b) With voice and 144 Kbps packet data service.	To be furnished by equipment supplier
s.	System Gain (Antenna port of BTS to Antenna port of RS)	To be furnished by equipment supplier.
t.	Range of automatic power control used to increase system gain & to equalize BTS receive power level from various the remote stations wherever applicable	To be furnished by equipment supplier
u.	Echo cancellation technique	To be furnished by equipment supplier

5.2	**BTS**	
(i)	**Transmitter:**	
a.	Nominal Transmit Power per sector per carrier	As per TIA/EIA/IS-2000
b.	Tx Power Limits	As per TIA/EIA/IS-2000
c.	Transmitter Frequency Accuracy	As per TIA/EIA/IS-2000
d.	Wave Form Quality	As per TIA/EIA/IS-2000
e.	Channel Allocation in full band of operation.	As per TIA/EIA/IS-2000
f.	Open Loop Output Power (i) For Access Channel (ii) For Enhanced Access Channel	As per TIA/EIA/IS-2000
g.	Closed Loop Power Control	
g.	Minimum Controlled Output Power	As per TIA/EIA/IS-2000
h.	Tx Spurious Emission at Antenna port	As per TIA/EIA/IS-2000
i.	Time Reference (Within ± 1µsec)	
j.	Code Domain Power	As per TIA/EIA/IS-2000
k.	Pilot Power	As per TIA/EIA/IS-2000
l.	(i) Pilot Time Tolerance (ii) Pilot Channel to Code Channel Time Tolerance (iii) Pilot Channel to Code Channel Phase Tolerance	As per TIA/EIA/IS-2000
m.	Protection against infinite VSWR	
(ii)	**Receiver :**	
a.	Receiver sensitivity (at 1% FER) and Dynamic Range	As per TIA/EIA/IS-2000
b.	Modulated adjacent and alternate channel de-sensitization or Single tone desensitization	As per TIA/EIA/IS-2000
c.	Inter modulation spurious response	As per TIA/EIA/IS-2000
d.	Rx Conducted Spurious Emission	As per TIA/EIA/IS-2000
e.	Reverse Traffic Channel Output Power during changes in data rate	As per TIA/EIA/IS-2000
f.	Adjacent Channel Selectivity	As per TIA/EIA/IS-2000
g.	Receive Signal Quality Indicator (RSQI)	As per TIA/EIA/IS-2000
5.3	**OMC**	OMC shall have the capacity to support at least : ii. 20 000 : Traffic Channels iii. 450 : Carrier Sectors iv. 16 : Command Line Interface (CLI) Users.

CHAPTER - 6

6. INTERFACES

6.1 BSC shall support IOS ver 4.0 or later, as per 3GPP2 A.S0001 based on TIA/EIA/IS-2000 with support for multiple E1 links (ports), upgradable to E3/STM-I links in future. BSC shall contain A, Ater, Aquinter and Aquarter reference points (as per 3GPP2 A.S0001-A, clause 1.7.1). These shall be implemented by the following interfaces :

(i) A interface by A1, A2 & A5 interfaces
(ii) Ater interface by A3 & A7 interfaces**.-** (Optional)
(iii) Aquinter interface by A8 & A9 interfaces – (Optional)
(iv) Aquarter interface by A10 & A11 interfaces.

Note: Full Technical details regarding implementation of interfaces (at each standard reference point) amongst different network elements as well as with other networks shall be provided by the supplier and no interface shall be proprietary in nature.

6.2 **Interface between BSC and MSC (defined as A1, A2, &A5 interfaces)**: Shall be as per IOS ver. 4.0 or later . Shall be on E1 links (2048 Kbps),upgradable to E3/STM-I Links.

6.3 **Interface between BSC & BTS (at the Abis reference point) :** Shall be on E1 links (2048 Kbps),upgradable to E3/STM-I Links. The same link shall be able to support both data and voice.

6.4 **Interface between BSC and BSC (defined as A3/ A7 interfaces)** *(* Optional) : Shall be as per IOS ver. 4.0 or later, compliant for inter-vendor, inter-BSC soft handoff. It shall be on E1 links upgradable to STM 1 links in future. Optionally support for Ethernet/WAN interface may also be provided. .

6.5 **Interface between BSC & PDSN (at the Aquater reference point) :** R-P Interface (defined as A10 and A11 interfaces) shall be as per IOS ver. 4.1 or later and it shall be implemented using E1 links, upgradable to E3/STM-I links. Optionally support for Ethernet/WAN interface may also be provided.

6.6 **Interface between: BSC & OMC**- Proper interface and interconnection shall be provided by equipment supplier and details furnished. It shall be possible to control multiple BSCs through a single OMC. Thus while the physical connection from the OMC to one BSC may be through LAN connectivity, connection to other remote BSCs shall be possible through WAN connectivity.

6.7 **Interface between BTS and RS (at the Um reference point) :** Air interface as per EIA/TIA IS-2000 standards.

The tendering authority, at the time of tendering may select, as per their requirement, the types of interfaces required as well as the number of such interfaces and ports.

CHAPTER-7

7.0 Tendering Information

At the time of tendering the equipment, the tendering authority may take a decision on the following issues/points:

7.1 The versions of all the documents mentioned in this GR may be reviewed and updated, if necessary. Refer clause 1.1.

7.2 The WPC has allocated the frequency band 824-844 MHz paired with 869-889 MHz at present. Any other frequency band (as per 3GPP2), allocated by WPC, may be specified, if required. Refer clause 1.14.

7.3 The registration methods required to be supported in the equipment may be specified. Refer clause 1.18.

7.4 Field Proveness : The tendering authority may mention the requirement of equipment being deployed in multiple countries and network & period of deployment. This may be mentioned as, "The equipment should have been field deployed commercially across multiple countries and network & for a reasonable period of time at least six months".

7.5 Redundancy of links between BTS-BSC and GPS receiver (along with other fixtures) if required, shall be indicated. Refer clause 3.5.

7.6 The tendering authority shall indicate the type of power supply on which the equipment shall operate. It shall also indicate whether any external power plant, if required, will be part of it or not and its technical requirements. Refer clause 4.15.1 .

7.7 Type (Indoor or outdoor), Numbers of BTS required, No. of RF Carriers & No. of sectors supported, may be indicated. Refer clause 5.1(e)

7.8 Tendering authority may get the actual RF survey and planning conducted prior to system planning for each site and may also identify the sites likely to cause interference with the already working wireless networks. It may also be indicated whether repeaters are required to be provide for coverage to the shadow regions/dark spots. Refer clauses 2.1 and 5.1(p).

7.9 Interference to existing networks : Tendering authority may ask the vendor to provide details of provisions made by them to ensure that there is no interference with the existing systems, wherever necessary. Refer clause 4.4.

7.10 The types of interfaces as well as the number of such interfaces and ports may be indicated. Refer chapter 6.

7.11 For testing the performance of BTS and BSC, the requirement of the following test instruments may be indicated :

(a) BTS tester : It shall be a compact portable unit, operated with internal rechargeable battery for minimum 2 hours. It should have following testing capabilities / features :

- Compatible to both IS-95 and cdma2000 technologies.
- Testing of E1 links/interfaces.
- The measurement of CDMA parameters should be possible without interrupting the network operation.
- Measurement of Antenna Gain, Feeder cable attenuation, VSWR, Return Loss etc.
- Power Meter with Sensor, for power measurement.
- CDMA Analyzer for Code Domain Analysis (CDA), Time Offset, PN Offset Measurements etc.
- Functionality of Spectrum Analyzer
- Functionality of CW Signal Generator

(b) IOS Protocol Tester capable of testing, at all layers, at least the following interfaces :

A1, A2, A5, A10 & A11.

NOTE : *TEC validation of the equipment is done under test/simulated conditions. Field Trial also is done with partially installed system and with limited number of test subscribers. It may not truly reflect the performance of the system in the field. Hence, the network (of which the equipment covered under this GR is a part) should be retested for its performance after its complete commercial deployment under loaded condition, for a suitable time period. Accordingly, necessary provision may be made in the tender.*

CHAPTER – 8

REFERENCES

TEC GRs

G/LLT-01	- Large Size Digital Local Cum Tandem Exchanges (Vol. I & II)
G/NIB-01	- National Internet Backbone
G/CDM-03	- CDMA Based Cellular Mobile Telecommunications System
GR/TML-01	- Remote Station (Subscriber Terminal) for CDMA Digital WLL System
S/EMI-02	- EMC standard for Telecommunication Equipments
GR/FDR-12	- Feeder Cable for CDMA and CorDECT WLL Systems
GR/ANT-20	- 800 and 1900 MHz WLL BTS Panel and Omni Antennas

QA Documents

QM 115	- Guidelines for Computing Reliability Figures.
QM 205	– Guidelines for Standard of Workmanship for Printed Boards
QM 206	– Guidelines for Standard of Workmanship for Printed Board Assemblies
QM 210	– Acceptability of Printed Board Assemblies Containing SMDs.
QM 301	– QA Requirements for Transmission Equipments.
QM 324	– QA Component Approval Procedures
QM 333	– Specification for Environmental testing of Sw. & Tx. Equipments
QM 351	– Quality Manual on QA Procedures for Switching Equipments.

ITU-T Standards

E.770	- Land mobile and fixed network interconnection traffic GoS concept.
E.800	- Terms and definition related to QoS and network performance.
G.165	– Echo cancellers
G.173	– Transmission planning aspects of the speech service in digital PLMN.
G.174	– Transmission performance objectives for terrestrial digital wireless systems using portable terminals to access the PSTN.
M.3020	- General philosophy of Operations and Maintenance (O&M)
M.3010	- General philosophy for network management

ITU-R Standards

M-1457	- Detailed specifications of the radio interfaces of IMT-2000.

Other Standards

ISO-9002	- 9001:2000
IS 8473	– Guide on the effects of current passing through the human body (equivalent to IEC publications 479-1)
IS 13252 (1992)	– Safety of information technology equipment including electrical business equipment (equivalent to IEC publication 95 and IEC 215)
CISPR 22 (2000)	- Limits and methods of measurement of radio disturbance characteristics f information technology equipment.
IEC 61000–4-4	- Testing and measurement techniques of electrical fast transients/burst immunity test.

IEC 61000 – 4 -3 - Radiated RF electromagnetic field immunity test.
IEC 61000 - 4 -5 - Test and measurement techniques for surge immunity tests.
IEC 61000 - 4 -6 - Basic immunity standard.

ANSI/EIA/TIA Standards

ANSI-41 - Core Network Standards for CDMA based Mobile Networks.
IS-125 - Recommended Minimum Performance standard for Digital Cellular
IS-127-2 - 8 Kbps EVRC vocoder.
IS-2000 - Standard for cdma 2000 1x based Networks.
IS-707 - Data Service options for spread spectrum system.
IS-833 - MC-MAP mode of operation.
IS-95 A - Air interface for 2G CDMA based Mobile Network.
IS-96 Rev A - 8 Kbps vocoders.
IS-733 - 13 Kbps vocoder

3GPP2 Standards

A.S0001 - Access Network Interfaces Inter-Operability Specifications (IOS)
C.S0002 - CDMA 2000 System – Physical Layer
C.S0003 - CDMA 2000 System – Layer 2 (Link Layer)-MAC sub-layer
C.S0004 - CDMA 2000 System – Layer 2 (Link Layer)-LAC sub-layer
C.S0005 - CDMA 2000 System – Upper Layers
C.S0010 - Recommended minimum performance of BTS
C.S0012 - Minimum performance standard for speech service option .1.
C.S0014 - Enhanced Variable Rate Codec (EVRC)

Note : All references are w.r.t. the latest versions/releases along with all amendments/ addendums.

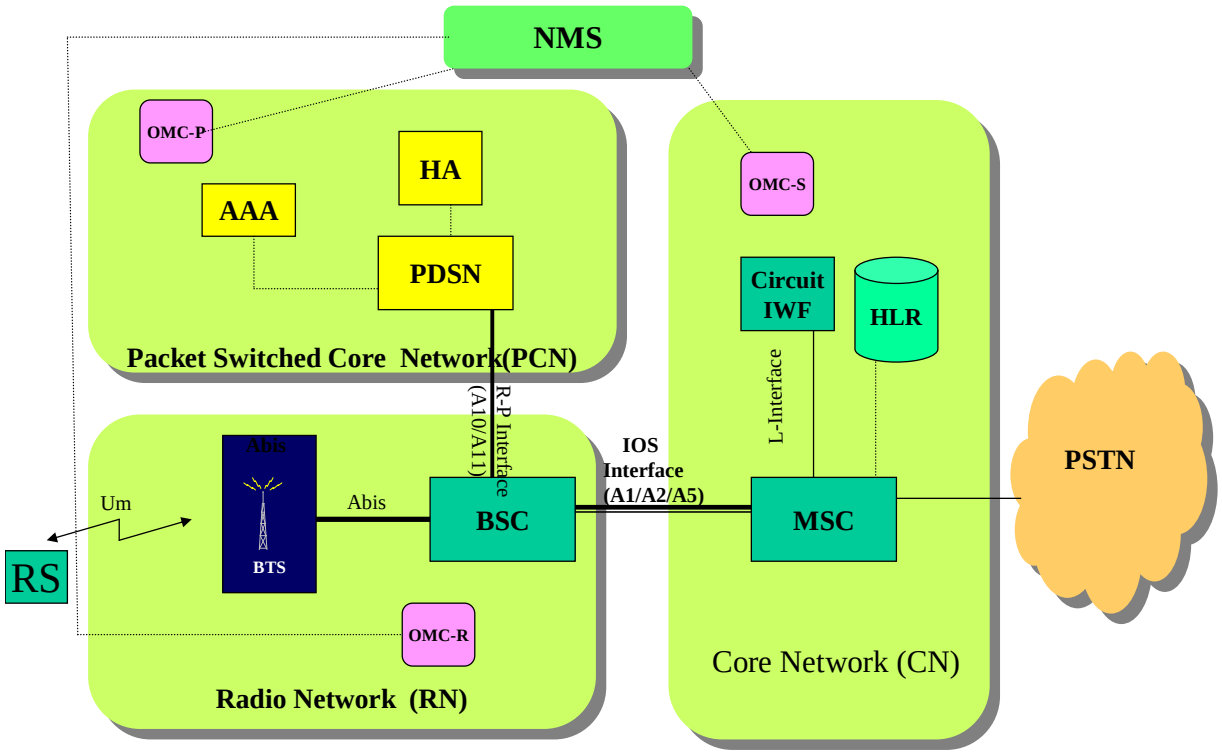
GLOSSARY

3GPP2	-	Third Generation Partnership Project 2
ANSI	-	American National Standardisation Institute
BHCA	-	Busy Hour Calling Attempt
BSC	-	Base Station Controller
BSNL	-	Bharat Sanchar Nigam Limited
BTS	-	Base Transceiver
CN	-	MSC based Core Network
CDMA	-	Code Division Multiple Access
CDR	-	Call Data Records
DIN	-	Deutsches Insitut fur Normung (German standard)
D.O.T.	-	Department of Telecommunications
dB	-	Decibel
DO	-	Data Only (Optimized)
DV	-	Data & Voice
E1	-	Digital Data Circuit Operating at 2.048 Mbps
E3	-	Digital Data Circuit Operating at 34.368 Mbps.
EMC	-	Electro-Magnetic Compatibility
Er/FA	-	Erlangs per Frequency Allotted
Ev	-	Evolution
EVRC	-	Enhanced Variable Rate Codec
FER	-	Frame Error Rate
FWT	-	Fixed Wireless Terminals
GOS	-	Grade of Service
GPS	-	Global Positioning System
GR	-	Generic Requirements
GSM	-	Group Special Mobile
IETF	-	Internet Engineering Task Force
IEC	-	International Electro-technical Commission
IOS	-	Interfaces inter-Operability Specification
IPv6	-	IP Version 6
IS	-	Interim Standard
ISDN	-	Integrated Services Digital Network
ISO	-	International Standardization Organisation
ITU-T	-	International Telecommunication Union (Telecom Sector)
LPA	-	Linear Power Amplifier
LAC	-	Link Access Control
MTNL	-	Mahanagar Telephone Nigam Limited
MAC	-	Media Access Control
MAP	-	Mobile Application Part
Mbps	-	Mega bits per second
MHz	-	Mega Hertz
mm	-	millimeter
MSC	-	Mobile Switching Centre
MTBF	-	Mean Time Between Failure

MTTR	-	Mean Time to Repair
OMC	-	Operation and Maintenance Centre
PCB	-	Printed Circuit Board
PCF	-	Packet Control Function
PCN	-	Packet Switched Core Network
PDSN	-	Packet Data Serving Node
PSPDN	-	Packet Switched Public Data Network
PSTN	-	Public Switched Telephone Network
Q.O.S.	-	Quality of Service
QA	-	Quality Assurance
QCELP	-	Qualcomm Code Excited Linear Prediction
QM	-	Quality Manual
RF	-	Radio Frequency
RFC	-	Request For Comments
RN	-	Radio Network
R-P Interface	-	RAN to PSDN Interface
RS	-	Remote Station
SDCA	-	Short Distance Charging Area
SMS	-	Short Message Service
SMV	-	Selective Multi rate Vocoders
STM-I	-	Synchronous Transport Multiplexer at speed 155.520 Mbps
TFO	-	Tandem Free Operation
TIA/EIA	-	Telecom Industry Association/Electronic Industry Association
TMN	-	Telecom Management Network
Tx	-	Transmitter
UCT	-	Universal Co-ordinated Time
VSWR	-	Voltage Standing Wave Ratio
WLL	-	Wireless Local Loop
WAN	-	Wide Area Network

ANNEXURE -I

Generic Model of cdma2000 1x WLL System



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