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Proprietary

**FCC ID AB6NT1900FRM**

# Exhibit E

## User Documentation

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Proprietary

# **NORTEL CDMA METRO CELL (MetroDE -- MetroRE)**

**800/1900 MHz**

## **Outdoor Cell Site Requirements**

Issue 0.02

Document: NORTEL CDMA Metro Cell (MetroDE -- MetroRE)  
Cell Site Requirements  
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NORTEL Wireless Networks  
CDMA BTS Radio Development  
BTS Radio Systems 2M41

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# **1.0 *Executive Summary***

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The CDMA Outdoor Metro Cell is a new product development for Nortel's wireless markets in North America. Metrocell targets the high capacity market. This document details cell site requirements for the Outdoor CDMA Metro Cell product. The Metro Cell can be configured in a 800 MHz, 1900 MHz, or mixed frequency variants. The document addresses initial deployment requirements and also covers future expansion requirements.

## ***2.0 Introduction***

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This document outlines the cell site engineering requirements for the CDMA MCBTS 1900 System. Its intended audience is the cell site engineering team who will use this information on the capabilities of the MCBTS to plan the installation of the product at a cell site. the cell site engineering team should have expertise in mechanical, grounding, power, telecom and RF engineering.

Specifications in the Product Specification |agreement (PSA) shall take precedence over information in this document.

The MCBTS cell site requirements fall into six main categories:

- mechanical requirements
- grounding requirements
- power requirements
- signal interface requirements
- antenna requirements
- carrier requirements

The mechanical requirements cover the physical characteristics (weight, size), the mounting requirements and restrictions, and the shipping, hoisting, and lifting requirements of the Digital Enclosure/Rack and the Radio Frequency modules (RFM)

The MCBTS (Metrocell) will be deployed in a number of environments potentially both indoors and outdoors.

## 3.0 *Environmental Requirements*

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The external environmental operating condition requirements are described in this section. Table 3.1: list the MCBTS thermal ratings.

Table 3.1: MCBTS Thermal rating

Thermal Rating	Range
Operating Range: (Normal operation - 24 hours per day)	-40 deg.C to +50 deg.C -40 deg.F to +122 deg. F
Non Operating Range: (Storage) for 72 hours	-50 deg.C to +70deg.C -58 deg.F to +158 deg. F

## ***4.0 Mechanical Requirements***

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### ***4.1 Physical Specifications***

The MCBTS is comprised of a digital enclosure (DE) and radio frequency modules (FRM). The digital enclosure is designed to be mounted on the ground while the FRMs are designed to be installed in the radio enclosure (or radio rack).

### ***4.2 Digital Enclosure***

The DE is the main structural component in the MCBTS. The digital enclosure will house the rectifiers, equipment shelves, internal heating/cooling tray, heat exchanger internal loop fan assembly and provide for all necessary internal cable routing management.

The preliminary outside dimensions for the DE are illustrated below. These dimensions refer to the unpackaged height and are excluding the DEI which attaches to the left side and the heat exchanger which mounts on the top.

The dimensions are:

- Depth: 30"
- Height: 57" Max (excluding 15" high heat exchanger)
- Width 30"

The DE with no shelves will weigh an estimated 190 lbs.

### ***4.3 Digital Enclosure Interface***

The Digital Enclosure Interface (DEI) for the MCBTS enclosure assembly provides entrance of the AC power, network and alarm connections, and connection to the ground ring. The dimensions of the DEI are shown below.

The dimensions are:

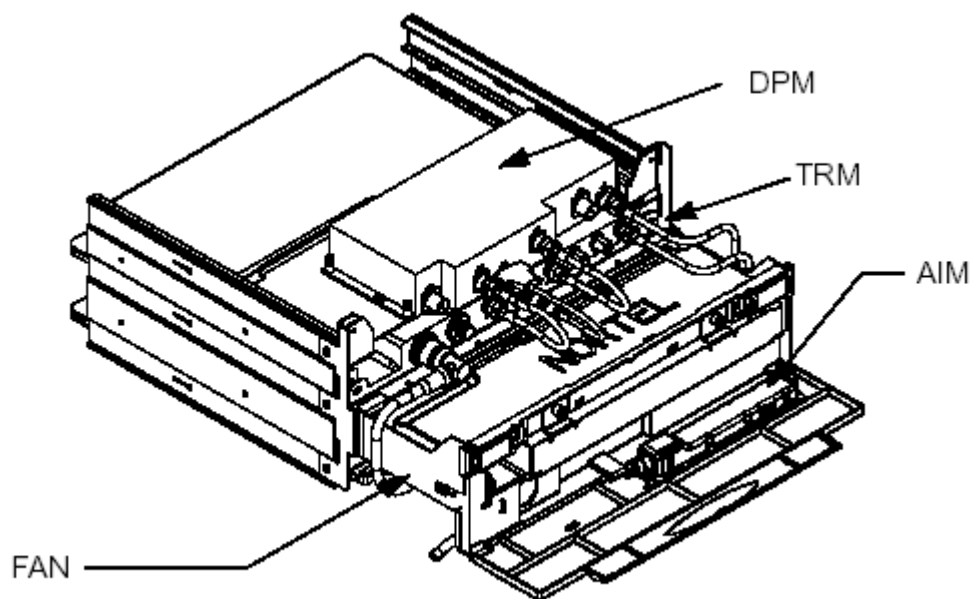
- Depth: 30" (same as overall depth of Digital Enclosure)
- Height: 72"
- Width 12"

The weight of the empty DEI is estimated to be 225 lbs. The loaded module weight after integration of equipment is expected to be 700 lbs. Cable access to the DE is via DE interface (DEI).



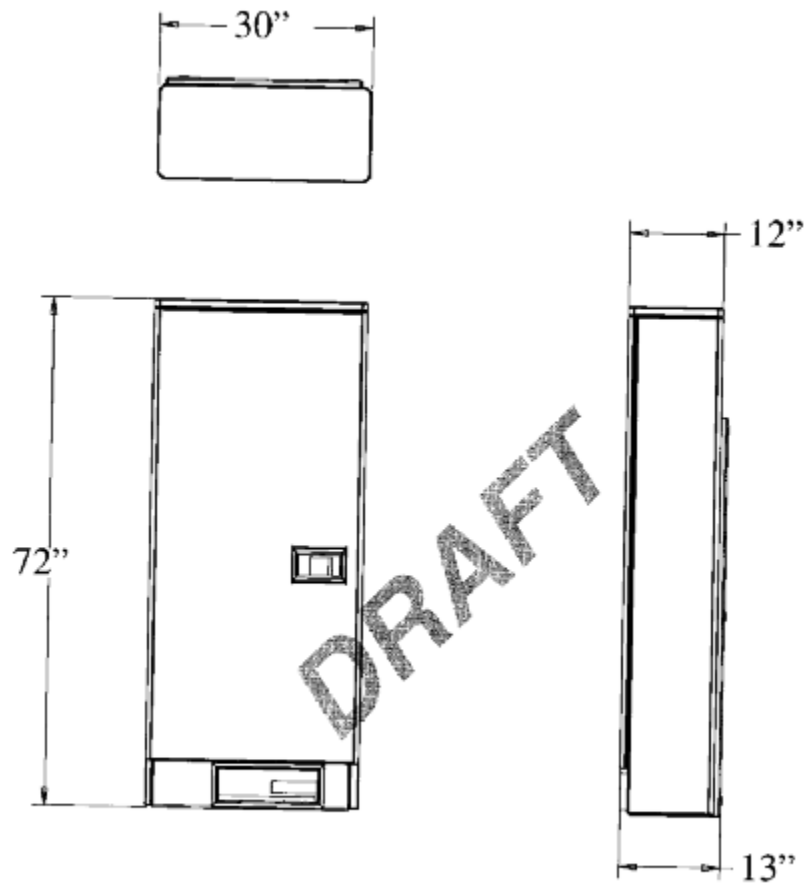
#### **4.4 External Battery Cabinet**

The MCBTS external battery cabinet (EBC) is an optional stand alone enclosure that provides additional battery backup to the digital enclosure. It will be located adjacent to the DE at the installation site and allow for one additional EBC to be daisy chained together to provide additional battery backup.



The EBC utilizes the DE as its external enclosure for environmental protection. four lifting eyes are provided at the top of the EBC for installation at the cell site.





#### **4.4.1 FRM**

The FRM is illustrated in Figure xyz.

Each FRM consists of the following main components: duplexer pre-selector module (DPM) or triplexer module, transmit receive module (TRM), power amplifier module (PAM) and fan/plenum assembly. The alarm indicator module (AIM) is located within the fan unit housing. The PAM, TRM, and fan unit have the same mechanical dimensions for both 800 MHz and 1900 MHz configurations. The 800 MHz DPM is taller than the 1900 MHz DPM.

#### **4.5 General Cabinet Anchoring**

The DE is designed to be hoisted by a crane. Four mounting points are provided on the top of the cabinet for hoisting.

#### **4.6 Pad mounting**

The MCBTS shall be mounted on a concrete slab

#### **4.7 Rubber Isolation Pad**

The DE shall be mounted on a rubber pad.

## **5.0 AC Power Requirements**

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### **5.1 Power Specifications**

Commercial AC power will be supplied to the DE as a single/split-phase, 120/240 Vac nominal, or 120/208 nominal Vac two of three phases, four conductor (L1, L2, Neutral and Ground) connection from an external service entrance.

The DE ac power input requirements are as follows:

- Nominal Input Voltage: 240/120 Vac, single, split phase, 50/60 Hz
- Input Voltage Range: 178 to 264 Vac
- Input Frequency: 47 - 63 Hz
- Power factor: greater than 90% at nominal line voltage and frequency
- Input current rating 70A, 2-pole circuit breaker

### **5.2 AC Power Connection**

All external AC power enters the system via the AC panel in the DEI. Primary power is by connection to the AC utility. A four wire (L1, L2, Neutral, and ground), nominal 240/120V (or 208/120V), 100A rating, ac supply must be supplied by the customer. The main breaker from the customer supply should be 100A. If the DEI is to be the service entrance, the neutral-groundjumper in the ac panel should be connected. Otherwise, it should be removed.

Auxiliary AC power access is via the external AC generator receptacle connector.

## 6.0 *RF Overlay Requirements*

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The Metro Cell has several overlay options

- Basic installation configuration (single channel)

- Simple overlay or mini configuration

The Metro Cell can accommodate 1900 MHz FRM's, 800 MHz FRM's, or combinations of both.

The FRM is illustrated in Figure 16. Each FRM consists of the following main components: duplexer pre-selector module (DPM) or triplexer module, transmit receive module (TRM), power amplifier module (PAM) and fan/plenum assembly. The alarm indicator module (AIM) is located within the fan unit housing. The PAM, TRM, and fan unit have the same mechanical dimensions for both 800 MHz and 1900 MHz configurations. The 800 MHz DPM is taller than the 1900 MHz DPM.

The minimum requirement (1 carrier) is 2 antennas per sector, one for the main path (Tx and one diversity path) and one for the other diversity path. A two carrier system can also be supported with two antennas. In this case, each antenna carries one carrier on the Tx side and one diversity path on the Rx side. With a three carrier system, a third antenna is added to carry just the Tx of the third carrier

Table 6.1:

Number of Carriers	Number of Antennas per Sector
1	2
2	2
3	3

### 6.1 *Cable Connections*

The optical link cable, SFRM DC power cable and the GPS antenna cable have a provisionable length. When ordering, the length must be specified and fall below the maximum length specifications indicated.

The quantity of inter-DFRM cables required depends upon the application. In a single carrier system, no inter-SFRM cables are required. In 2 or 3 carrier systems, inter-SFRM cables are required.

Two sample configurations will be considered for illustrative purposes. These are:

- i) a basic system with no redundancy;
- ii) a premium system with all redundancy

## **7.0 *GPS Receiver***

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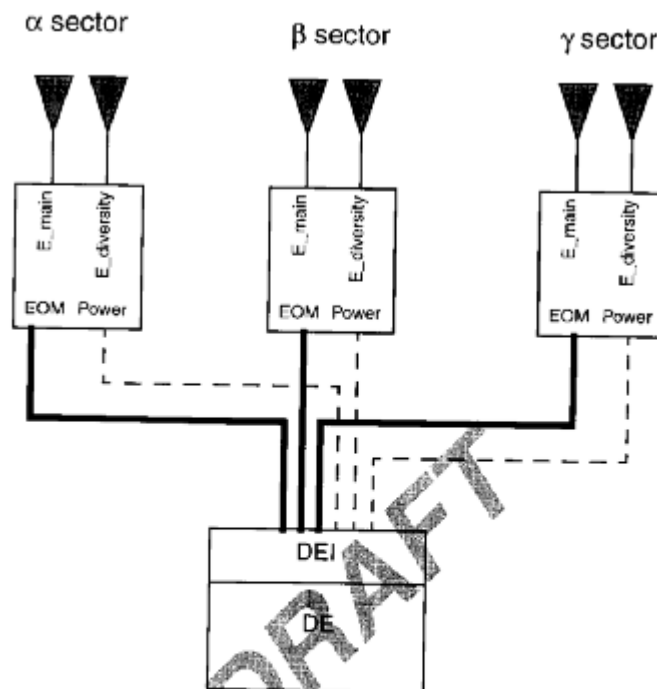
Timing and frequency reference information provided by the GPS receiver is critical to the proper operation of Metrocell subsystem. One or two GPS antennas may be connected. The GPS antenna receives the signals from multiple satellites, and the signal is supplied to the GPS receiver in the Metrocell via a coaxial cable. Precautions should be taken to ensure that the GPS antenna is clear of obstructions and interference.

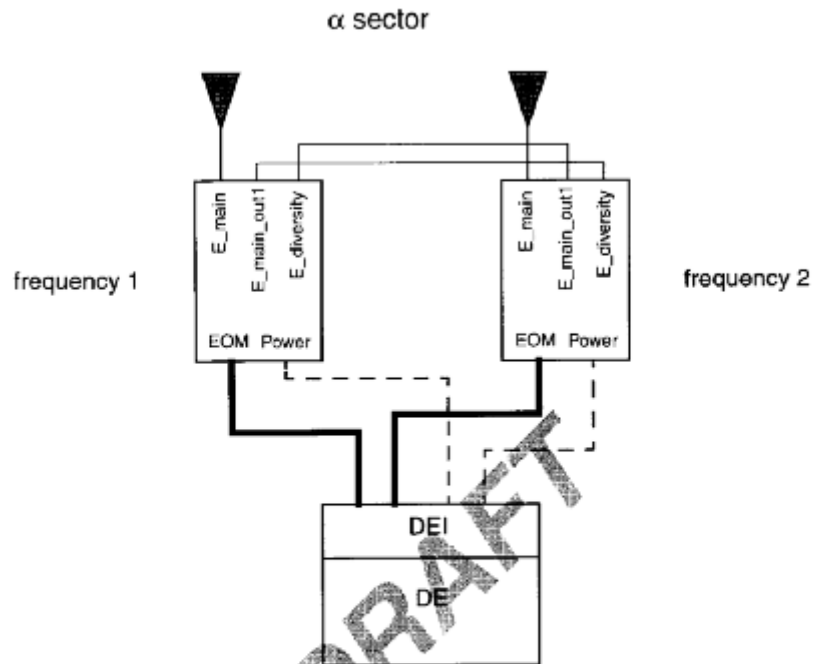
The antenna should be installed to provide the best view of the entire sky. A complete view of the sky from horizon to horizon will enable the receiver to observe as many GPS satellites as possible. This allows the GPS receiver to select the best combination of GPS satellites for best performance. If the GPS antenna must be installed with a limited view of the sky, it may not be able to track a sufficient number of satellites to determine its position. The GPS receiver must track at least 4 satellites simultaneously for some period of time in survey mode. Once the GPS receiver has an accurate fix on its location, it can maintain accurate timing signals to the BTS while tracking only one satellite.

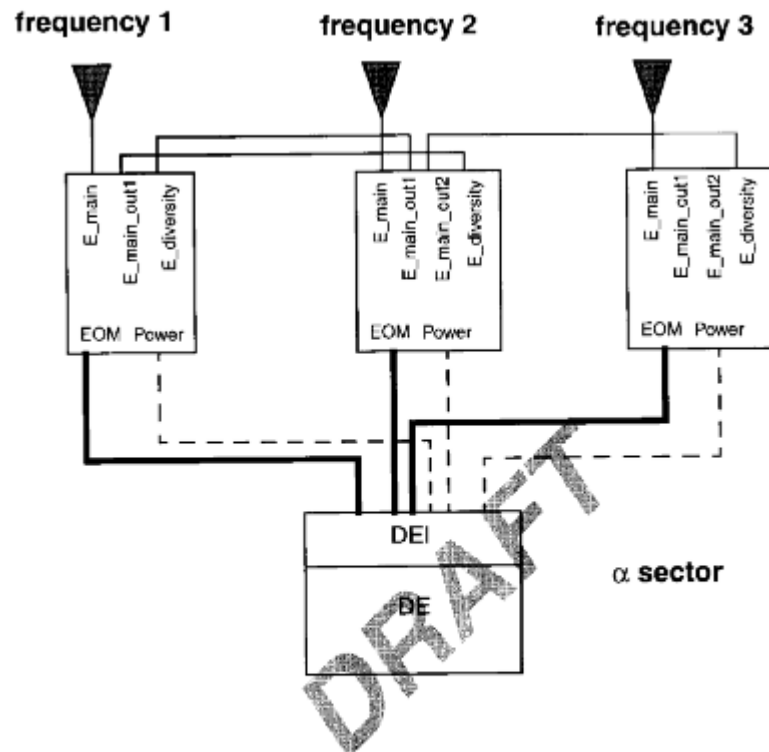
The maximum distance between Metrocell and GPS antenna is set by the maximum allowable cable loss of? dB. The cable length and type is required by the GPS receiver for determining the delay from antenna to the receiver.

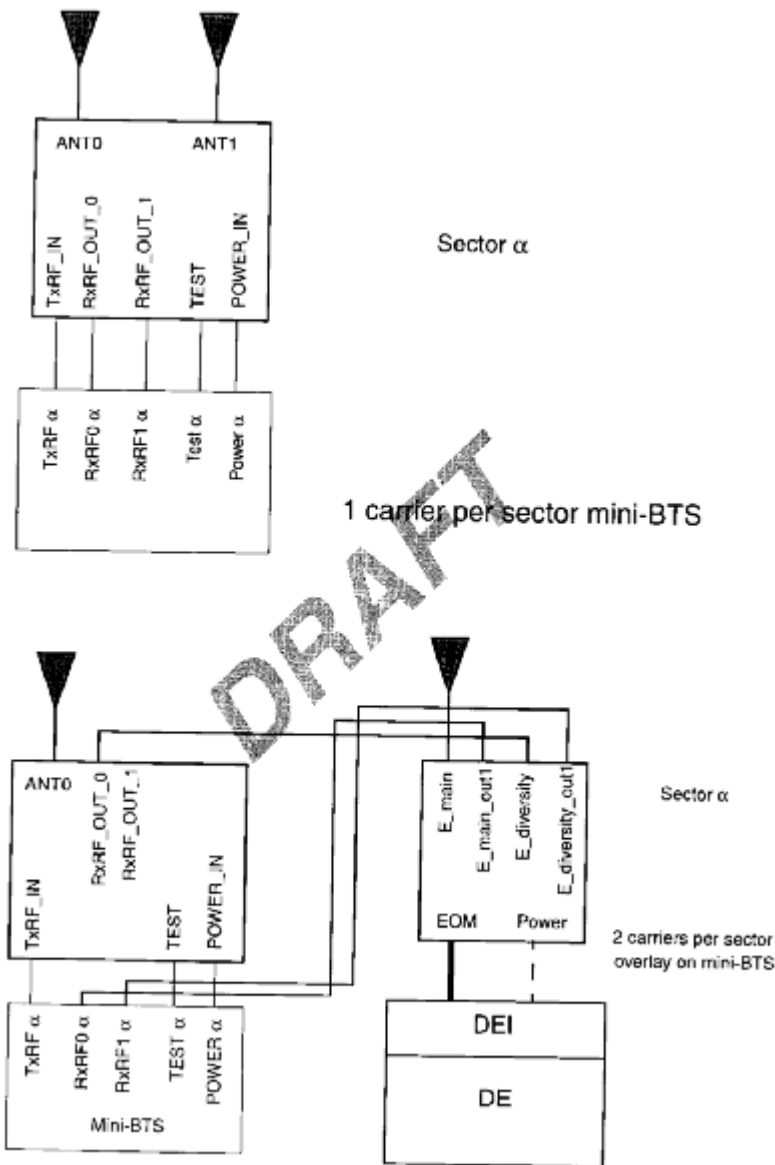


### Connections and Cabling









## **8.0 *Connections and Cabling***

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### **8.1 *FRM Power Connections and Cables***

DC power is conducted to individual FRMs via two conductor (-48V, BR) shielded (ground) cables, one cable for each FRM. The size of the power cable depends on the cable run length. The DC power cable from DEI enters the FRM enclosure via the Power Entry Module (PEM)

The specifications for these external FRM dc cables are as follows:

- less than 3000 feet, use 2 conductor #8 AWG shielded cable
- Between 300 and 600 feet, use 2 conductor #6
- Allowed cable voltage drop: 6 Vdc maximum (-48V and Rtn combined)
- Cable terminations: two-hole lugs at the DEI BRR plate, twist-lock type connector at FRM (to mate with the PEM)
- Shield termination: grounded at both the FRM and DEI ends, and at the base of the tower

The FRM DC cable is sized for voltage drop, not ampacity

The optical link enters the FRM via the electro-optic module (EOM)

### **8.2 *FRM Interconnect***

Table 8.1 next shows the FRM external interconnect single carrier configuration.

Table 8.1: FRM Interconnect

Name	Type	Format	# Pins	From	To	Note
E_pwr/ret	48VDC	DC	2	DEI	FRM	E_ in the name
E_gnd	GND	GND	1	DEI	FRM	designates a
E_shield	GND	GND	1	DEI	FRM	connection
E_rfm_rvs1	639.976 Mbs	optical	1	EOM	COR1	external to the
E_rfm_fwd1	639.976 Mbs	optical	1	COR1	EOM	FRM assembly
E_rfm_rvs2	639.976 Mbs	optical	1	EOM	COR2	
E_rfm_fwd2	639.976 Mbs	optical	1	COR2	EOM	

### 8.3 *Fiber*

The optical link to the FRM contains 4 fibers per link. two receive and transmit pairs for redundancy, unless multi carrier deployment is used, when soft redundancy is handled by the other carrier and only two fiber are used (other two left unused). The main portion of the link will run on outside plant cable capable of vertical ascent, terminated at the FRM by a standard SIECOR optifit termination. The transceivers will be housed in a heated optical termination unit which is connected to the FRM by electrical interconnect. The high speed signals will be carried by 4 coaxial links.

Fiber interconnect and rearrangement features are required to interconnect the FRMs to the Digital enclosure. Current baseline design has the digital enclosure provisioned with a optical link harness, fiber storage and management, as well as flexibility point (splice point) in the DEI cabinet capable of handling all 48 fibers in the fully configured case.

The FRM has an EOM which depends upon the length of the fiber run from the DE to the FRM

## **9.0 T1/E1 Connections**

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The CM module has up to 6T1 interfaces connected through the backplane. The cable will probably be lumped in two 12 wire bundles terminated at the digital shelf backplane by two 15 pin dsubs.

The Metro Cell can be connected to the BSC using 1 to 6 T1/E1 links. These T1/E1 links are distributed between the two DCGs i.e. if one DCG has 4 T1/E1s connected to it then the other can have a maximum of two T1/E1 links. All T1/E1s connected to each DCG need to have the same timing reference at the BSC. Each link requires 2 twisted pairs.

There are two ways of connecting T1/E1 to the Metro Cell. The T1/E1 cables can be directly brought into the DEI or they can be connected to a RJ48H connector which interfaces with the DEI. The RJ48H connector cable NTGS0106 is provisionable. In the DEI T1/E1 connections are done on the middle and lower blocks among the three Telephone/Data Line Protection blocks as shown in Figure 87. The RJ48H connector is shown in Figure 88 and the pinout is shown in Table 30.

The number of T1/E1s that need to be connected to the Metro Cell depends on the call carrying capacity of the T1/E1s and the number of calls that a Metro Cell has to make. The number of T1/E1 that need to be provisioned for a Metro Cell can be determined from Ref [10].

The two modes of operation of Metro Cell are regular (or non-split) mode or split mode. In the regular mode only one DCG is active, the other DCG may not be provisioned or is a redundant DCG. In the split mode both DCGs are provisioned and are active. Each DCG in the split mode is a logical BTS. The T1/E1 connections of the Metro Cell in the regular and split mode are done as shown in Table 27.

The T1/E1 lines are connected to one of the two BTSI cards in the control module (CM)

**Table 27: T1/E1 Connections of Metro Cell without Daisy Chaining**

Connector Port	Regular Mode	split mode with connections on different DCG
span 0	T1/E1 # 1	T1/E1 # 1 for BTS#1
span 1	T1/E1 # 2	T1/E1 # 2 for BTS#1
span 2	T1/E1 # 3	T1/E1 # 3 for BTS#1
span 3	T1/E1 # 4	T1/E1 # 3 for BTS#2
span 4	T1/E1 # 5	T1/E1 # 2 for BTS#2
span 5	T1/E1 # 6	T1/E1 # 1 for BTS#2

The T1/E1 lines are connected to one of the two BTSI cards in the control module (CM) which forms part of the DCG. The connections are controlled by relays and are exclusive to one DCG. Therefore if T1/E1 #1 is connected to the first DCG then the same lines cannot be connected to the other DCG. This is true in regular as well as split mode. In regular mode since only one DCG is active, therefore, all the T1/E1s are connected to the active DCG. When the redundant DCG takes over then the connections are switched to it by closing the relays on this new active DCG and opening them on the previously active DCG. The middle column of Table 27 shows how the T1/E1 connections are done for the active DCG in regular mode. In the split mode each DCG is active and is part of the logical BTS. Therefore, each DCG has its own independent T1/E1 connections. The right column of Table 27 shows how the T1/E1 connections are done for the two logical BTSs in the split mode. It is clear from [1] that a single DCG, supporting a maximum of two carriers, does not need more than 3 T1/E1 connections. So, the connections shown in Table are reasonable and will provide for a redundant T1/E1 link per logical BTS in most cases (keeping in mind the number of T1/E1 links needed for 2 carriers as mentioned in [10]).

The Metro Cell can be configured for a shorthaul link or a longhaul link. In case of a shorthaul configuration the Metro Cell should be within 655ft of the last repeater while for a longhaul link the Metro Cell should be within 6000ft of the last repeater using 22 gauge unshielded twisted pair cable i.e. 100 ohm 22 gauge cable. The shorthaul and longhaul link is configured using software. The distance of the Metro Cell from the last repeater-



has to match the software configuration.

# **10.0 Grounding**

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## **10.1 BTS grounding Architecture**

The FRM is grounded to its mounting structure, whether a tower, wall, building or pole. for outdoor Metrocell or the radio rack (Indoor Metrocell). If the structure is non-conductive (e.g. wooden pole) it shall be provided with a ground cable as part of the site ground.

The FRM mounting structure and BTS cabinets both connect to the site ground ring. #2 AWG cables less than ten feet long are used for these primary, external ground connections.

## **10.2 Antenna Grounding**

Each GPS antenna will be grounded at the antenna mast and again at the cable entry point (coax cable shield) inside the DEI. Similarly, the cell site antenna(s) are grounded at the tower and may be further protected by lightning rods on the mounting structure, protruding above the antennas, preventing direct strike to the.

## **10.3 Radio rack Grounding**

The common ground point in the RE is the subframe. A #2 AWG cable will connect the subframe to the main ground point in the DEI in the side-by-side configuration. When the RE is installed remotely from the DEI/DE the ground cable will connect the subframe to the site ground in that area. Attachment shall be made with two hole compression lugs.

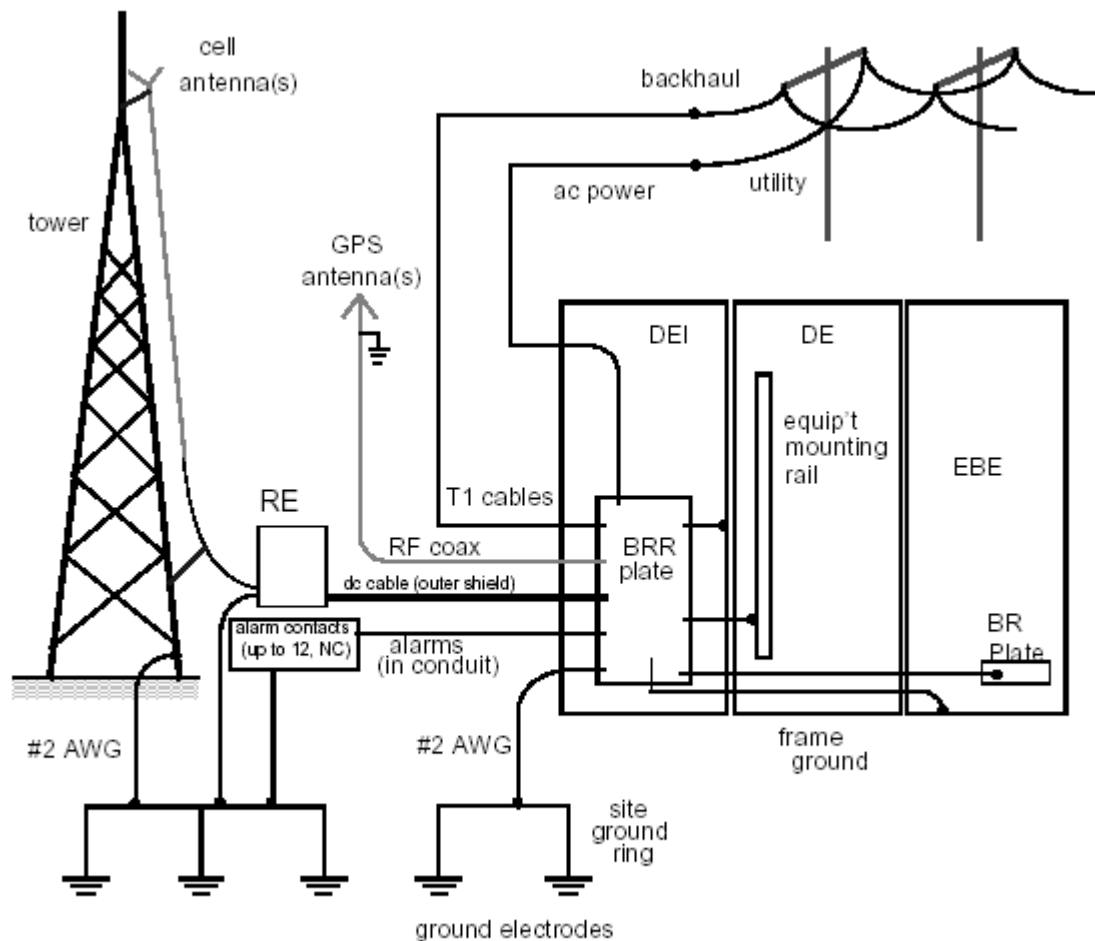
The shield of the DC power cable connecting the main electronics cabinet to the FRM shall be grounded at both the FRM end and the main enclosure end (main ground plate)

Provision one NTGS0161 main site ground cable for the DEI/DE and one for every RE.

## **10.4 Site Ground Ring**

A peripheral grounding ring, usually buried around the site perimeter, or routed along the outer edge of the roof of a building, provides the main site ground. It provides an equipotential reference to minimize differential voltages during lightning surges. It consists of a #2 AWG (or larger) uninsulated, tinned copper conductor. Connections are made to it using C-tap clamps.

### Fig. 10.1 Cell Site Grounding Connections



## ***11.0 References***

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  - [2] CDMA MCBTS 1900 Outdoor. Power Protection and Grounding Design Specification. by Ed Norman
  
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  - [6] MCBTS Digital Enclosure Mechanical Assembly NTGS13AA Functional Agreement. Packaging Concepts Methodology.
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