OPENCELL
OPERATIONS AND MAINTENANCE
MANUAL

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TABLE OF CONTENTS

Section Page

LIST OF ILLUSTRATIONS

LIST OF TABLES

Table Page

SAFETY CAUTIONS AND INSTRUCTIONS

Definitions of Symbols Used in this Manual

General Caution

Hazardous Voltage

Hot Surface

RF Hazard

Protective Earth Ground

Frame or Chassis Ground

RAN Installation

- Only trained and qualified personnel should install, replace, or service this equipment. This includes service or replacement of cables and antennas.
- The RAN shall be installed and wired by licensed electricians in accordance with the National Electrical Code and local building codes.
- Electrical service shall accommodate the RAN maximum load of 10 amps at 240 VAC, 60 Hz. A readily accessible disconnect device must be incorporated near the point of power entry to the main RAN enclosure.
- The RAN and antenna shall be bonded and grounded in accordance with National Electrical Code requirements.

RAN Servicing Cautions

	High voltages are present within the RAN enclosures. Use extreme caution when working inside the equipment. Disconnect power to the equipment before servicing.
	Exterior surface of the RAN may be hot. Use caution during servicing.
	Do not work on the RAN or antenna or cables during lightning storms.
	Caution This system is a RF transmitter and continuously emits RF energy. Maintain 3 foot minimum clearance from the antenna while the system is operating. Wherever possible, shut down the RAN before servicing.

HUB Installation

- Only trained and qualified personnel should install, replace, or service this equipment.
- The OpenCell HUB shall be installed and wired by licensed electricians in accordance with the National Electrical Code and local building codes.
- Electrical service shall accommodate the HUB FIR maximum load of 21(?) amps at –48 VDC, and the HUB BIR maximum load of 7(?) amps at –48 VDC. A readily accessible disconnect device must be incorporated near each point of power entry to each HUB rack.
- The HUB shall be bonded and grounded in accordance with National Electrical Code requirements.
- The HUB grounding (earth) terminal provided is intended to connect the equipment frame directly to local earth ground for personnel safety. To ensure proper operation of the equipment, connect the earth terminal to the protective earth conductor only.

HUB Servicing Cautions

Hazardous voltages are present. The inverter located in the HUB FIR converts 12 volts to 120 VAC. Use caution when servicing the equipment.

<u>FCC APPROVAL IN PROCESS</u>

FCC License Data

The OpenCell RAN has been authorized for use as a RF device under parts 15, 22, and 24 of the FCC rules.

The OpenCell equipment complies with FCC rules when the antennas and cables having characteristics and part numbers as specified in the instructions are used with the system. The installer and operator are responsible for ensuring that only the specified antennas and cables are used and properly installed.

Other than as specifically described in the product manuals, this product shall not be changed or modified by the operator without the express approval of Transcept Inc. Failure to do so may void the operator's or provider's authority to operate this equipment.

NOTE: The OpenCell Hub has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

<u>FCC APPROVAL IN PROCESS</u>

1.0 INTRODUCTION

This manual contains the Operation and Maintenance procedures for the OpenCell system.

1.1 ABOUT THIS MANUAL

1.1.1 Scope

1.1.2 Manual Organization

1.2 TERMINOLOGY, ACRONYMS AND ABBREVIATIONS

1.2.1 Notations Conventions

1.2.2 Acronyms and Abbreviations

Common Items (Hub or RAN)

CPU	Central Processing Unit
NMS	Network Management System
BTS	Base Transceiver Station
BIF	Backplane Interface
STF	System Interface
SIF	Synchronous Interface (Fiber Interface)

HUB Specific

FIR	Fiber Interface Rack (formerly CompactPCI Rack)
BIR	BTS Interface Rack
N/HDC	Narrowband Hub Down Converter
W/HDC	Wideband Hub Down Converter
FSC	Forward Simulcast Card
RSC	Reverse Simulcast Card
HUC	Hub Up Converter
BIM	Base Station Interface Module
HRM	Hub Reference Module
RFIO	RF Rear I/O
DIO	Digital I/O
EHUB	Ethernet Hub
PSI	Power Supply Interface
BPS	BIR Power Supply

FPS	FIR Power Supply

RAN Specific

RUC	RAN Up Converter (Dual)
PA800	Power Amplifier(800 MHz)
PA1900	Power Amplifier(1900 MHz)
P/MCPLR	PCS Multicoupler
C/MCPLR	Cellular Multicoupler
RDC	RAN Down Converter
PQP	PCS Quadplexer
CTP	Cellular Triplexer
CDP	Cellular Diplexer
RECT	Rectifier
GB	Glitch Battery
RPS	RAN CompactPCI Power Supply
LVD	Low Voltage Disconnect
PIC	Power Amplifier Interface Controller
ANT	Multiband Antenna
BAT	Battery Backup Batteries
RAN	Basic Four Tenant RAN
ERAN	Expansion Eight Tenant RAN

1.3 REFERENCE DOCUMENTATION

1.4 SYSTEM OVERVIEW

The Transcept OpenCell system is an open access network supporting multiple wireless voice, data, video services and applications. Wireless Service Providers (WSP) and Wireless Internet Service (WISP) Providers use Transcept OpenCell to either enhance or replace existing networks, wired or wireless, or to develop new networks.

OpenCell is a multi-frequency, multi-protocol RF access network, providing microcellular Cellular, PCS, and wireless data coverage via a distributed RF access system. The OpenCell system is comprised of base station interfaces, located at hub locales, connected via high speed datalinks to Radio Access Nodes, commonly referred to as RANs, distributed over a geographical area of interest.

1.4.1 System Configuration

The following figure illustrates an OpenCell system with RANs distributed over a desired geographical area, connected back to a group of WSP base stations at a Hub locale.

The illustration shows utility pole mounted RANs, with pole top antennas. The OpenCell Hub Equipment is comprised of a number of Base Station Interface Racks (BIR) and Fiber Interface Racks (FIR) racks. The OpenCell Hub equipment provides the interconnection between at the RF layer between the WSP base station sector(s) and the OpenCell Radio Access Nodes.

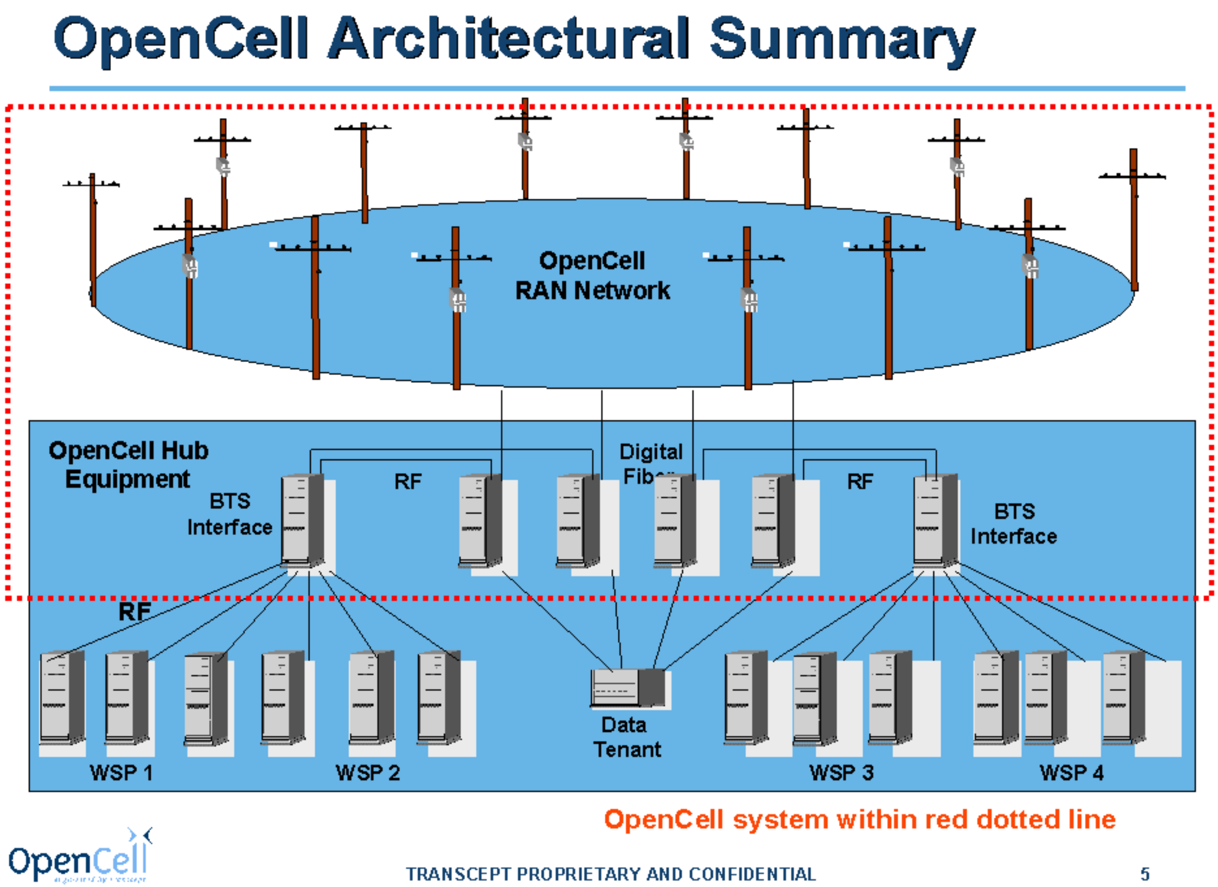

Figure 1. OpenCell Architectural Summary Diagram

1.4.2 General Description

The OpenCell system can be implemented in a number of ways to address the RF design objective of the WSP community. There are two classes of assemblies; common system and WSP specific assemblies, in both the Hub and RAN locations. This section of the document will describe what each assembly does and how it plays in the system. The block diagram in Figure 2 shows the RF signal path through the OpenCell system. The signal starts from the base station sector on the left flowing to the right (arrows pointing right) and radiating out from the multi-band antenna to a mobile subscriber. This is commonly referred to as the Forward Path. In the reverse direction, or what is commonly referred to as the Reverse Path, the RF signal starts from a mobile subscriber device, is received by the antenna and then flows from the RAN to the HUB and to the base station sector receiver(s).

The following figure illustrates each of the major assemblies.

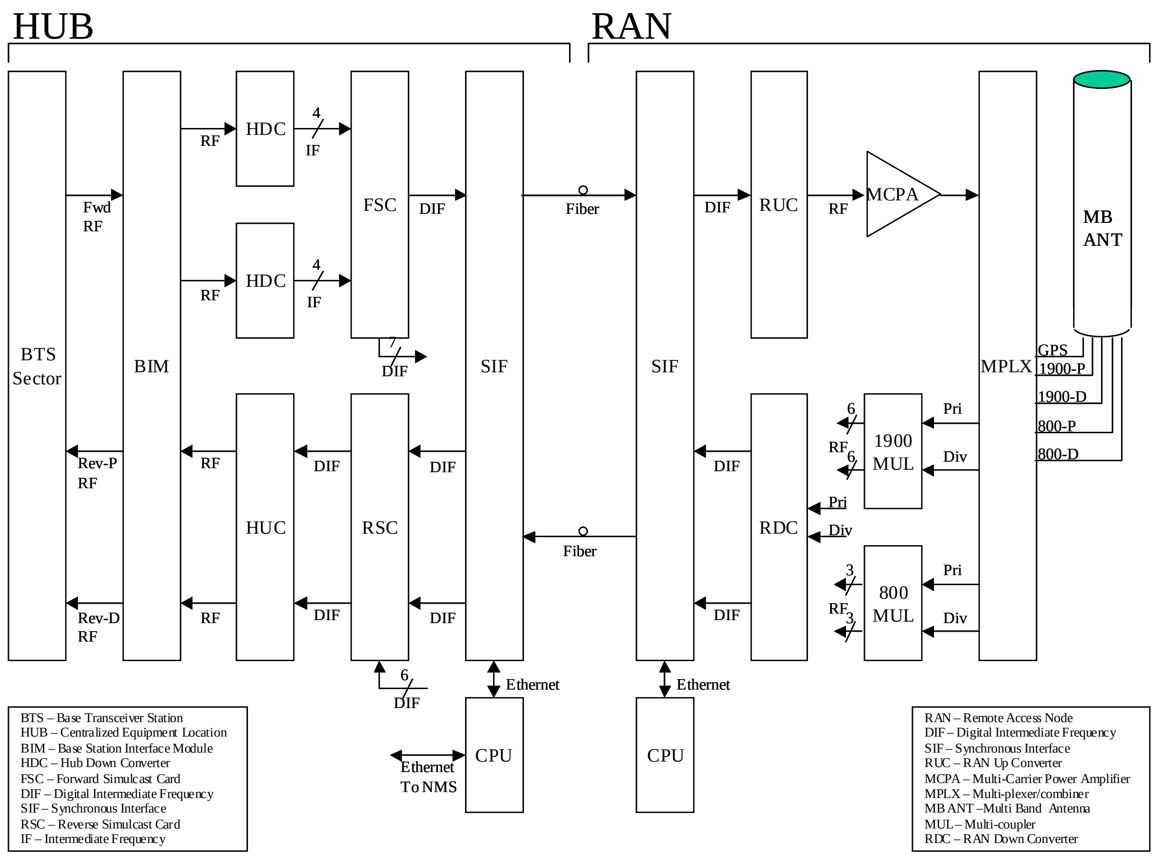

Figure 2. OpenCell Block Diagram

The Block diagram shows the functional flow and where each component of the OpenCell system resides. The following paragraphs in section 1.4.3 and 1.4.4 will describe each components function and contribution to the OpenCell system.

1.4.3 Hub Subsystem Assemblies

The Hub is comprised of two rack types. These include the Base Station Interface Rack, referred to as the BIR and the Fiber Interface Rack, commonly referred to as the FIR.

The BIR is houses the following modules in varying quantities;

1) BIR Power Supply Module. This module provides the 12V necessary to power the base station interface modules, referred to as a BIM. Each BIR power supply module is comprised of a hot-swappable shelf design and two (2) power modules.

   One BIR Power Supply Module is required per 12 BIMs, or one rack

2) Base Station Interface Module, or BIM. The BIM is a multi-port transition module used to interface with the WSP's base station sector. The BIM accepts either duplexed or simplexed RF from the base station sector and provides the to the OpenCell RF section separate transmit and receive paths. The BIM is unity gain, with a nominal noise figure of 5dB, contributing negligible noise in the reverse path.

The FIR is houses the RF signal processing and and data transport modules. There are two primary chassises in the FIR, referred to as the Digital and RF chassis. The Digital and RF chassis follow CompactPCI standards for form, size and functionality.

The Digital Chassis houses the following circuit cards;

1) The CPU
2) The System Interface card, STF
3) The Wideband Digital Optical Transport card, WBDOT
4) The Reverse Simulcast card, RSC
5) ‘CompactPCI Power Supply

The functionality of each of these card assemblies will be defined in the following section.

The RF Chassis houses the following circuit cards;

1) The Hub DownConverter card, HDC
2) The Hub UpConverter card, HUC
3) The Forward Simulcast card, FSC
4) CompactPCI Power Supply

The functionality of each of these card assemblies will be defined in the following section.

1.4.3.1 Base Station Interface Module (BIM)

The Base Station Interface Module provides the following BTS interface functionality:

1. Interface to a high power forward BTS path
2. Interface to a low power forward BTS path
3. Handles duplexed and non-duplexed signals
4. Added gain to adjust for different reverse path configurations

The BIM is controlled via an I2C connection from its CPU.

1.4.3.2 BIR Power Supply

The BIRPS provides +12VDC for all BTS Interface Modules.

1.4.3.3 Central Processing Unit (CPU)

The Hub CPU is a x86 machine with hard disk running LINUX. The Hub CPU performs the following functions:

1. Master Hub Process controlling all Tenant specific functions
2. Manages a subset of Hub hardware including RF and Digital equipment
3. Manages RANs connected to it Hub managed hardware.

1.4.3.4 System Interface (STF)

The System Interface (STF) module provides the ability to communicate between the CPU and other modules (HDC, FSC, HUC, PSI, BMI & HRM) using four I2C busses. The STF also communicates with the GPS module found in the Master Hub Reference Module.

The four I2C busses are accessible via the CompactPCI backplane or via front panel connectors.

1.4.3.5 Synchronous Interface (SIF)

The Synchronous Interface module provides the fiber interface between the Hub and RANs. This interface includes:

1. RF Signal information
2. 10BaseT Ethernet for command and control between Hub and the RANs.

1.4.3.6 Hub Down Converter (HDC)

The HDC down converts the forward RF channel to an intermediate frequency (IF) that can be digitized. Each HDC can support up to four separate RF channels. A second HDC may be installed to support 8 RF channels.

1.4.3.7 Forward Simulcast Card (FSC)

The Forward Simulcast card converts the IF signals from the HDC to Digitized IF(DIF) format. There are eight separate analog to digital conversion circuits on an FSC.

1.4.3.8 Reverse Simulcast Card (RSC)

The RSC sums the Digital IF (DIF) from up to eight RANs into a single DIF signal that is sent to the HUC for conversion to RF.

1.4.3.9 Hub Up Converter (HUC)

The HUC accepts two Digital IF (DIF) signals from a SIF or RSC. The DIF signals are digital to analog converted and translated to a pair of RF signals (diversity).

1.4.3.10 Hub Reference Module (HRM)

The HRM generates the RF reference and fiber clocking for distribution within a Fiber Interface Rack. In addition, it contains a GPS that generates a 1PPS for distribution to the Digital equipment for delay management.

1.4.3.11 Ethernet Hub

Each FIR rack is equipped with a 24 port Ethernet Hub, at the top of the rack, below the HRM.

1.4.3.12 RF I/O Module (RFIO)

The RFIO provides the ability for a CPU to communicate with an I2C device in another chassis. Each STF module and HUC has an RFIO installed in the rear of the chassis. Cables connect the RFIO modules I2C connections. In addition, the RFIO is used to provide clock and reference to all CompactPCI chassis for use by the boards.

1.4.3.13 Digital I/O Module (DIO)

The DIO provides the ability for connecting DIF signals between multiple CompactPCI chassis. Cables are used to connect the DIO modules DIF connections.

1.4.3.14 RF CompactPCI Chassis & Backplane

The CompactPCI RF Chassis houses the RF transceiver modules, HUC and HDC, and the Forward Simulcast Module. The backplane provides the distribution for clock, communication and control data and timing. RF and digital RF signals are interconnected between modules using the appropriate cabling. The appropriate data signal cabling is provided to interconnect the RF Chassis backplane to the STF in the Digital Chassis.

1.4.3.15 Digital CompactPCI Chassis & Backplane

The CompactPCI RF Chassis houses the CPU, System Interface Module, and Reverse Simulcast Module. The backplane provides the distribution for clock, communication and control data and timing. The digital RF signal from the RSC is interconnected to the HUC in the RF Chassis using the appropriate cabling.

1.4.3.16 FIR CompactPCI Power Supply

Each CompactPCI chassis has its own power supply. Eech supply has modules that support N+1 redundancy. The supply provides +/-12V, 5V and 3.3V DC.

1.4.3.17 Power Supply Interface (PSI)

The PSI is used to monitor the discrete outputs from the BIR anf FIR power supplies. The CPU communicates with this module using an I2C interface.

1.4.3.18 Ethernet Hub Power Inverter (EHPI)

The EHPI provides 120VAC for the Ethernet Hub in each Fiber Interface Rack. The input is 12VDC.

1.4.4 RAN Subsystem Assemblies

1.4.4.1 Central Processing Unit (CPU)

The RAN CPU is a x86 machine with hard disk running LINUX. The RAN CPU performs the following functions:

1. Manages all RAN hardware including RF and Digital equipment

1.4.4.2 System Interface (STF)

The System Interface (STF) module provides the ability to communicate between the CPU and other modules (RDC, RUC, PIC) using four I2C busses. The STF also contains the GPS module.

1.4.4.3 Synchronous Interface (SIF)

The Synchronous Interface module provides the fiber interface between the Hub and RANs. This interface includes:

1. RF Signal information
2. 10BaseT Ethernet for command and control between Hub and the RANs.

1.4.4.4 RAN Down Converter (RDC)

The RDC is a dual-diversity wideband receiver that converts PCS, Cellular and SMR800 signals to digitized IF. It also includes a CW test tone used in reverse continuity testing.

1.4.4.5 RAN Up Converter (RUC)

The RAN Up Converter converts digitized IF into PCS, Cellular and SMR frequency bands. Each RUC supports two simultaneous wideband outputs.

1.4.4.6 RAN Chassis & Backplane

The RAN chassis is a standard CompactPCI unit. The backplane supports the basic CompactPCI functions and has been extended to allow the routing of DIF, reference clocks and I2C signals between CompactPCI modules.

1.4.4.7 CompactPCI Power Supply (RPS)

The CompactPCI Power Supplies provide +/-12V, 5V and 3.3 V DC power to the CompactPCI backplane for use by CompactPCI modules. These units are redundant and hot swappable.

1.4.4.8 RAN Rectifier (RCT)

The RAN rectifier converts 240 VAC prime power into –48VDC for use with the RAN. It also manages the batteries (glitch or 2hr).

1.4.4.9 Power Amplifier (PA)

The Power Amplifiers are multi-carrier and can provide up to 10 watts (total) for a given Tenant. Different units are used for PCs, Cellular and SMR800.

1.4.4.10 PA Interface Controller (PIC)

The PA Interface Controller is managed by the CPU over an I2C connection. The PIC interfaces to the discrete signals of the Power Amplifier. The PIC also converts from -48VDC to +12VDC or +28VDC depending upon which PA is being used. Each PA has its own PIC module.

1.4.4.11 Multiplexers

The multiplexers consist of four units that interface the antenna to the RAN PAs and multicouplers. There are four types found in every RAN:

1. Quadplexer Primary (PCS Bands A, B, F), interfaces to PCS primary antenna
2. Quadplexer Diversity (PCS Bands D, E, C), interfaces to PCS diversity antenna
3. Triplexer Primary (Cellular Band B, SMR800 band), interfaces to 800 MHz primary antenna
4. Diplexer Diversity (Cellular Band A), interfaces to 800 MHz diversity antenna

1.4.4.12 PA Fans

These fans are mounted in the RAN door shroud and provide the cooling of the PAs mounted on the door by blowing external air across heatsink. They are controlled by a thermistor mounted to the door heatsink. The STF module monitors the TAC outputs of the fans.

1.4.4.13 Fuses

There are 6 fuses in the RAN that protect the –48VDC distribution:

1. Four 15 amp fuses for the PA/PICs
2. 1 15 amp fuse for the CompactPCI chassis
3. 1 5 amp fuse for the fans

1.4.4.14 Battery Backup (BB)

The battery backup system consists of a –48VDC battery string (4 batteries) contained in a separate enclosure that provides up to 2 hours of backed up power for the RAN.

1.4.4.15 Glitch Batteries (GB)

The glitch battery system consists of –48VDC battery string contained within the RAN and can provide 5 minutes of backed up power for the RAN.

1.4.4.16 Multicoupler (PCS and Cell)

The multicouplers interface to the multiplexer system and contain the front end low noise amplifiers for the reverse path. They are dual-diversity receive for the PCS and 800 MHZ bands. The PCS band has 12 outputs (bands A-F, with diversity). The 800 MHz has 6 outputs (Cell bands A,B and SMR800, with diversity).

1.4.4.17 Antenna (ANT)

The multiband antenna is designed reside on the top of a utility. It will interface with the PCS and Cellular/SMR bands and contains diversity receive paths. Also included is the GPS antenna used by the RAN.

1.4.5 Communication Interfaces

1.4.5.1 I2C

I2C is a two-wire, bidirectional serials bus that provide a simple, efficient method of data exchange between devices. It is primarily used in the consumer and telecom market sector and as a board level communications protocol.

I2C interfaces are used for communication to the following modules:

1. Hub - HDC, FSC, HUC, BIM, PSI
2. RAN - RDC, RUC, PIC

1.4.5.2 Network Interface

The Hub CPUs are able to communicate to any other CPU in the Hub over an Ethernet LAN. Ethernet connections are aggregated with each rack via an Ethernet Hub. Intra-rack communication is possible by connecting the Ethernet Hubs between racks.

Each SIF has an 10BaseT Ethernet connection. The Hub CPUs are able to communicate with the RANs over this Ethernet connection.

1.4.5.3 SNMP/IP

SNMP/IP is the primary interface to the OpenCell equipment for performing OA&M functions.

2.0 POWER ON/OFF PROCEDURES

This section contains the procedures for powering on and off OpenCell equipment.

Warning

The CPU is not Hot Swappable. Damage can occur if attempted. Insure tbat the CPU is installed before applying power to system

2.1 HUB POWER-ON/OFF

Hub Rack Power On

1. Power to the Hub racks (BIR or FIR) is enabled at the Power Distribution Unit (PDU).

Hub Rack Power Off

1. Power to the Hub racks (BIR or FIR) is disabled at the Power Distribution Unit (PDU).

Hub CompactPCI Chassis Power On

1. Power to a CompactPCI chassis enabled by inserting the modules within the power supply below the chassis

Hub CompactPCI Chassis Power Off

1. Power to a CompactPCI chassis disabled by extracting the modules within the power supply below the chassis

2.2 RAN POWER ON/OFF

RAN Equipment Power On

1. Turn circuit breaker on at the load center located near the bottom of the utility pole AND switch the rectifiers AC switch, located in the top section of the RAN, to the ON position
2. The DC power, from either the glitch battery or the two hour battery must also be connected. Connecting the “molex” type connector at the contactor does this. See picture below.

RAN Equipment Power Off

1. Turn the circuit breaker off at the load center located near the bottom of the utility pole OR switch the rectifiers AC switch, located in the top section of the RAN, to the OFF position
2. The DC power, from either the glitch battery or the two hour battery must also be disconnected. Disconnecting the “molex” type connector at the contactor does this. See picture below.

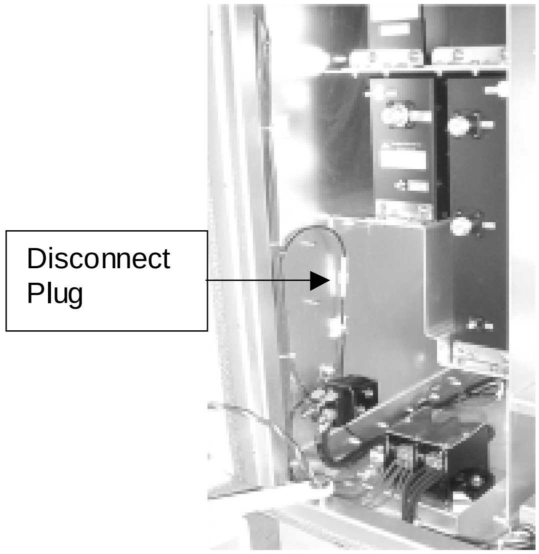

Figure 3. Battery LVD Disconnect Plug

3.0 CONTROLS AND INDICATORS

3.1 COMMON TO HUB AND RAN

3.1.1 CPU

The front panel controls for the CPU are:

- Reset – Recessed reset button

The front panel indicators for the CPU are:

- Activity LEDs – 8 Yellow LEDs flashing when the OS is operating

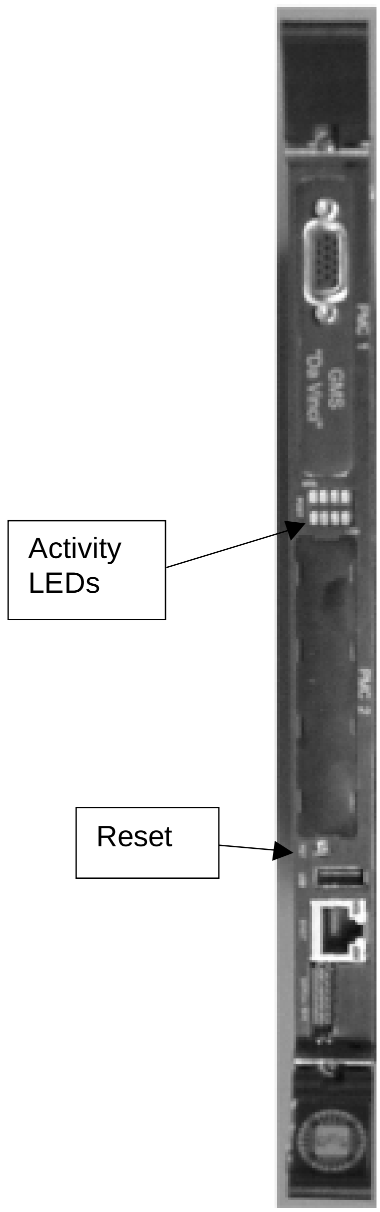

Figure 4. CPU Front Panel

3.1.2 STF

The front panel controls for the System Interface are:

- RST – Reset switch, recessed button

The front panel indicators for the System Interface are:

- Status LED 1/2 – Yellow LED. Reserved for future use.
- GPS LED – Green LED indicating 1PPS (Ran only)
- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power
- I2C Comm LED – On each I2C RJ-45 connector. Green LED lighted when I2C message sent, red LED when no response on interface
- I2C Error LED – On each I2C RJ-45 connector. Red LED when no response on interface
- HS LED – Blue LED, turns blue when board can be hot swap extracted

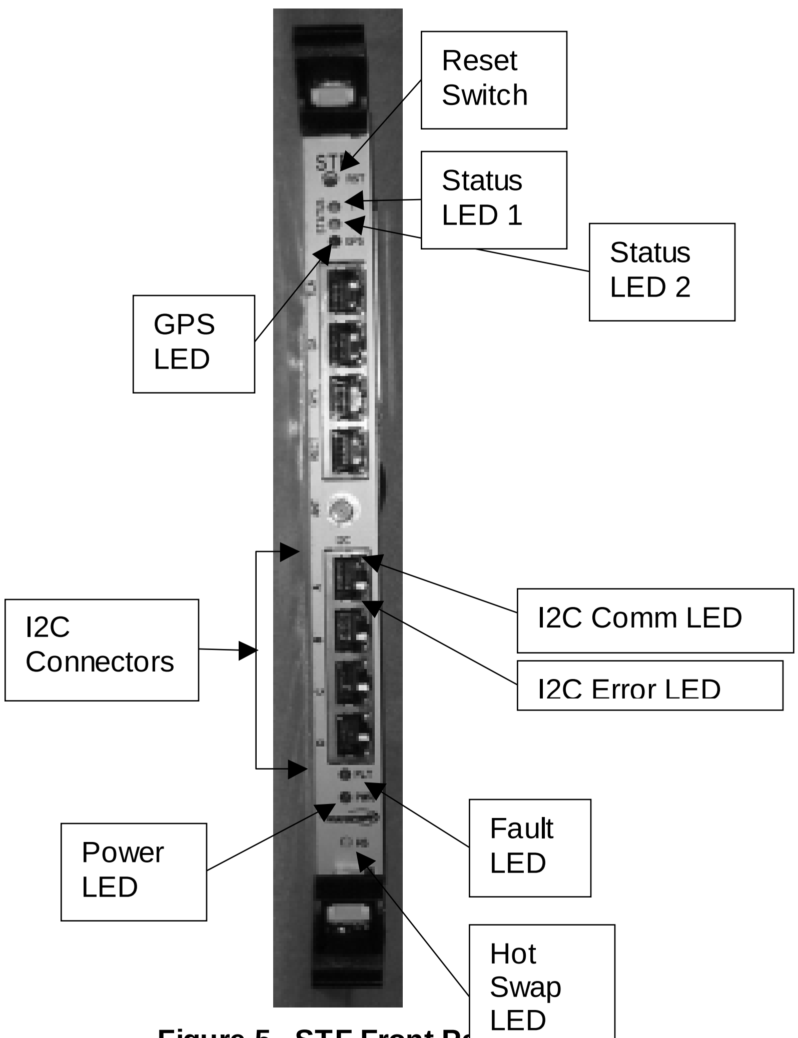

Figure 5. STF Front Panel

3.1.3 SIF

The front panel indicators for the Synchronous Interface are:

- In 1-4 LED – DIF Input Tri-color LED
    - Off = Interface not enabled
    - Green = good
    - Yellow = bad
    - Red = bad
    - Flashing = Interface is in and out of lock
- Out 1-4 LED – DIF Output Tri-color LED
    - Off = Interface not enabled
    - Green = good
    - Yellow = N/A
    - Red = bad data on DIF input caused by Alarm Indication Signal (AIS)
- OP IN LED – Optical Input Tri-color LED
    - Green = good
    - Yellow = N/A
    - Red = bad, bad framing, bad parity, no signal
- OP OUT LED – Optical Output Tri-color LED
    - Green = good
    - Yellow = N/A
    - Red = bad output
- FLT LED – Red fault LED lighted when module is failed
- PWR LED – Green Power LED lighted when module has power
- HS LED – Hot Swap Blue LED, turns blue when board can be hot swap extracted

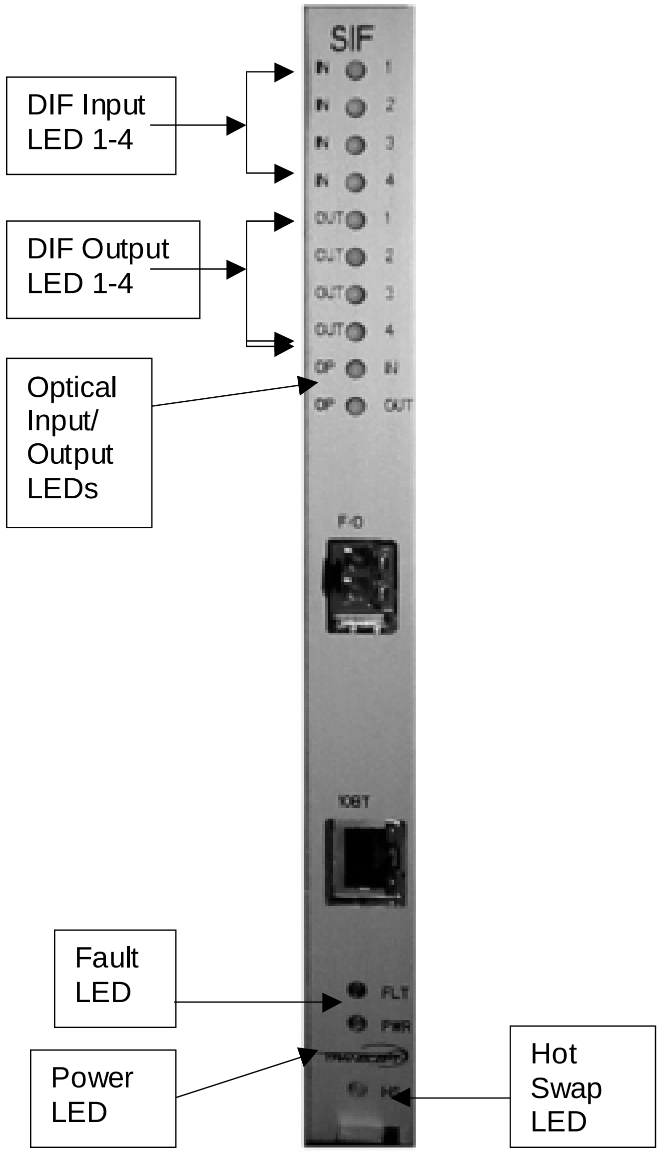

Figure 6. SIF Front Panel

3.2 RAN

This section describes the various controls and indicators for RAN specific modules.

3.2.1 RDC

The front panel indicators for the RAN Down Converter are:

- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power

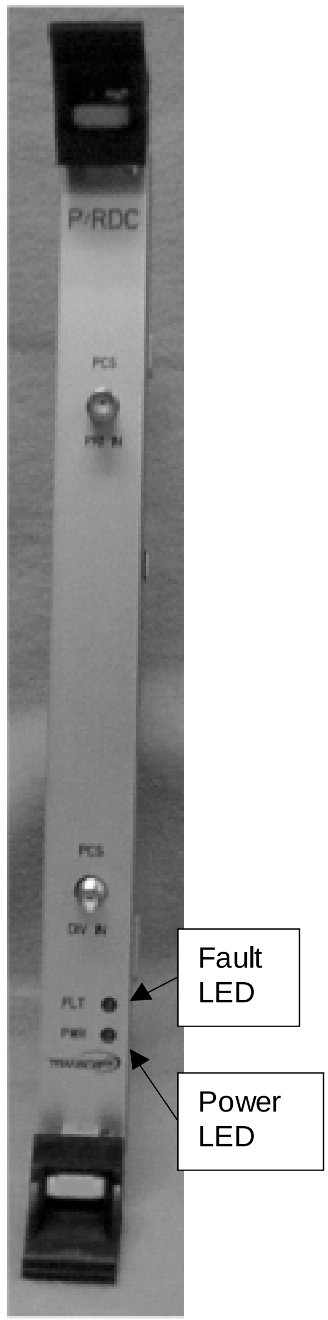

Figure 7. RDC Front Panel

3.2.2 RUC

The front panel indicators for the RAN Up Converter are:

- COM 1/3 – Yellow LED indicting I2C communications to PICs 1/3
- COM 2/4 – Yellow LED indicting I2C communications to PICs 2/4
- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power

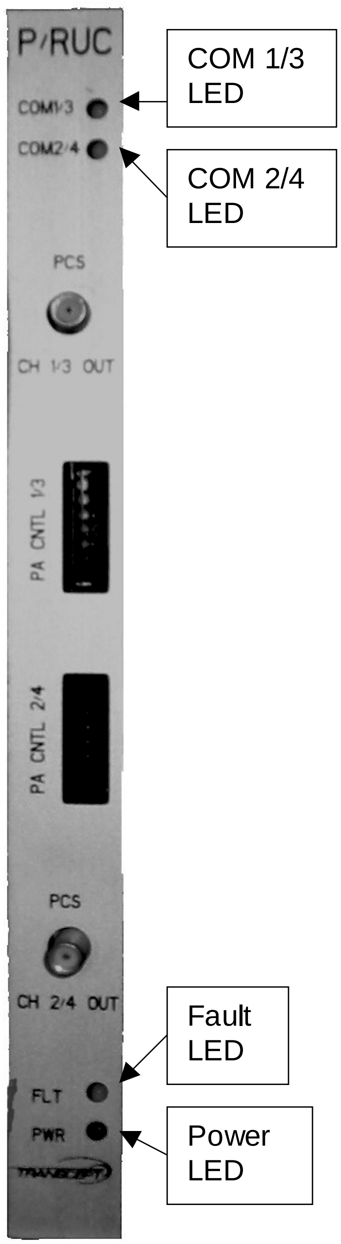

Figure 8. RUC Front Panel

3.2.3 P/MCPLR

The front panel indicators for the PCS Multicoupler are:

- FLT LED – Red Fault LED lighted when module is failed
- PWR LED – Green Power LED lighted when module has power

Figure 9. C/MCPLR Front Panel

3.2.4 C/MCPLR

The front panel indicators for the Cellular Multicoupler are:

- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power

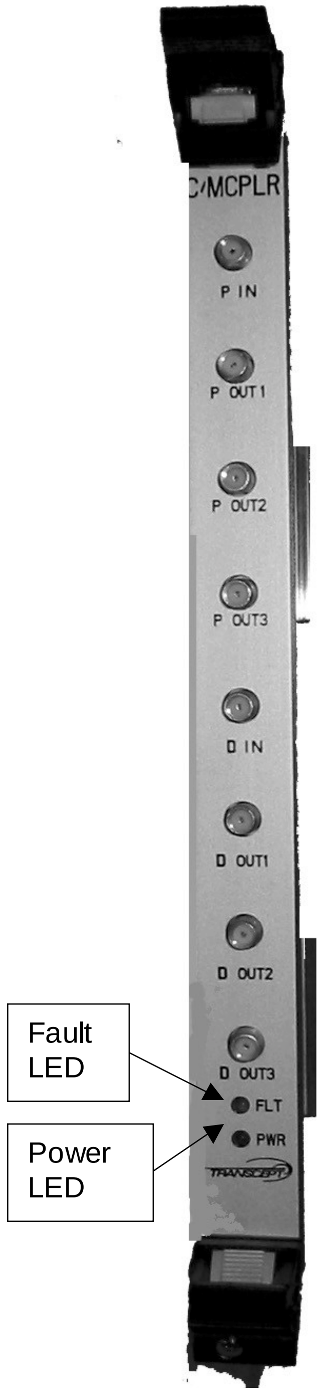

Figure 10. C/MCPLR Front Panel

3.2.5 PIC

The front panel indicators for the PA Interface Controller are:

- -48VDC LED – Green LED lighted when module has –48VDC input
- 5VDC LED – Green LED lighted when module has 5VDC power
- 12VDC LED – Green LED lighted when module has 12VDC power
- RF ON LED – Yellow LED, lighted when RF is present on input to PA
- PS LED – Red LED lighted when power supply has failed
- PA LED – Red LED lighted when PA has failed (not currently supported)

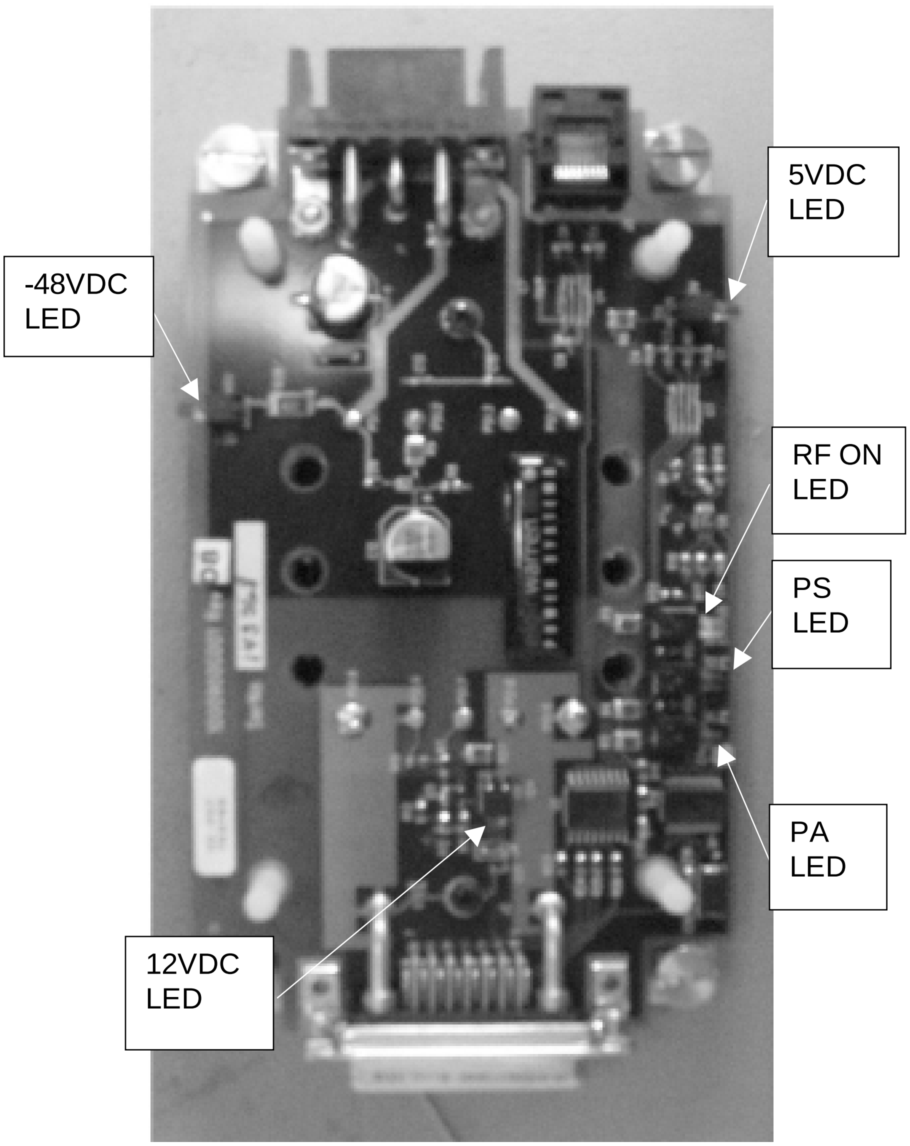

Figure 11. PIC Front Panel

3.2.6 CompactPCI Power Supply

The front panel indicators for the RAN CompactPCI power supplies are:

- Fault LED – Yellow LED lighted when module is failed
- Power Good LED – Green LED lighted when module has power

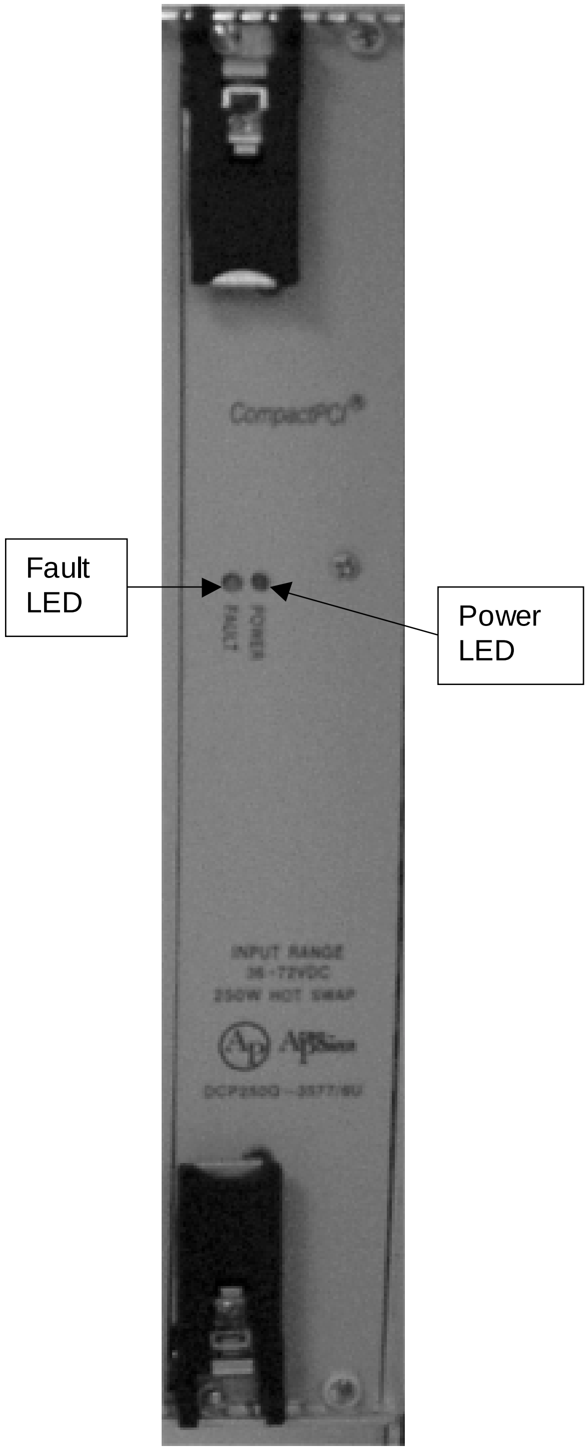

Figure 12. CompactPCI Power Supply Front Panel

3.2.7 Rectifier Front Panel

The front panel indicators for the RAN rectifier are:

- AC ON (Green) - Lighted when AC is present
- CL (Yellow) – Lighted when unit is current limiting
- RFA (Red) – Lighted when rectifier has failed

The front panel controls are:

- AC on/off toggle switch
- CL adjustment screw - Current limit adjustment. Factory set.
- FLO adjustment screw – Float voltage adjustment. Factory set.

The front panel test points are:

- I-/I+ - Current draw adjustment. Factory set.

Figure 13. RAN Rectifier Front Panel

3.2.8 RAN Rectifier Chassis Front Panel Controls and Indicators

The front panel indicators for the RAN rectifier chassis are:

- FL (Green) – Float voltage indicator
- EQU (Yellow) – Equalizer charge voltage
- HV (Red) – High Voltage Condition
- LV (Red) – Low Voltage Condition
- MN (Org) – Minor Alarm
- MJ (Red) – Major Alarm
- HVSD (Red) – High Voltage Shutdown
- AC Fail (Red) – AC Missing
- Fuse Alm – Not Used
- LVDS Open – LVDS in open state

The front panel controls are:

- FL/EQU – Float voltage equalizer alarm reset button
- HVSD RST – High Voltage Disconnect alarm reset button
- SMR RST – SMR Reset Button

The front panel connectors are:

- 9-pin RS-232 connector – Interface to STF module
- ETH – Ethernet connection, Not Used

The front panel test points are:

- I-/I+ - Current draw adjustment. Factory set.
- V-/V+ - Current draw adjustment. Factory set.

Figure 14. RAN Rectifier Controller Front Panel

3.3 HUB

This section describes the various controls and indicators for RAN specific modules.

3.3.1 HDC

The front panel indicators for the Cellular Multicoupler are:

- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power
- CDMA LED – Yellow LED indicating Wideband HDC
- GSM/TDMA LED – Yellow LED indicating Narrowband HDC

Figure 15. Hub Down Converter Front Panel

3.3.2 FSC

The front panel indicators for the Forward Simulcast Card are:

- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power

Figure 16. Forward Simulcast Card Front Panel

3.3.3 HUC

The front panel indicators for the Forward Simulcast Card are:

- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power
- P/Lock LED – Yellow LED lighted when Primary path is locked
- D/Lock LED – Yellow LED lighted when Diversity path is locked

Figure 17. Hub Down Converter Front Panel

3.3.4 RSC

The front panel indicators for the Cellular Multicoupler are:

- IN 1-4 LEDs – DIF Input Tri-color LEDs
    - Off = No input signal
    - Green = Good
    - Yellow or Red = Bad
- OUT 1-4 LEDs – DIF Output Tri-color LEDs
    - Off = No input signal
    - Green = Good
    - Yellow or Red = Bad
- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power
- HS LED – Hot Swap Blue LED, turns blue when board can be hot swap extracted

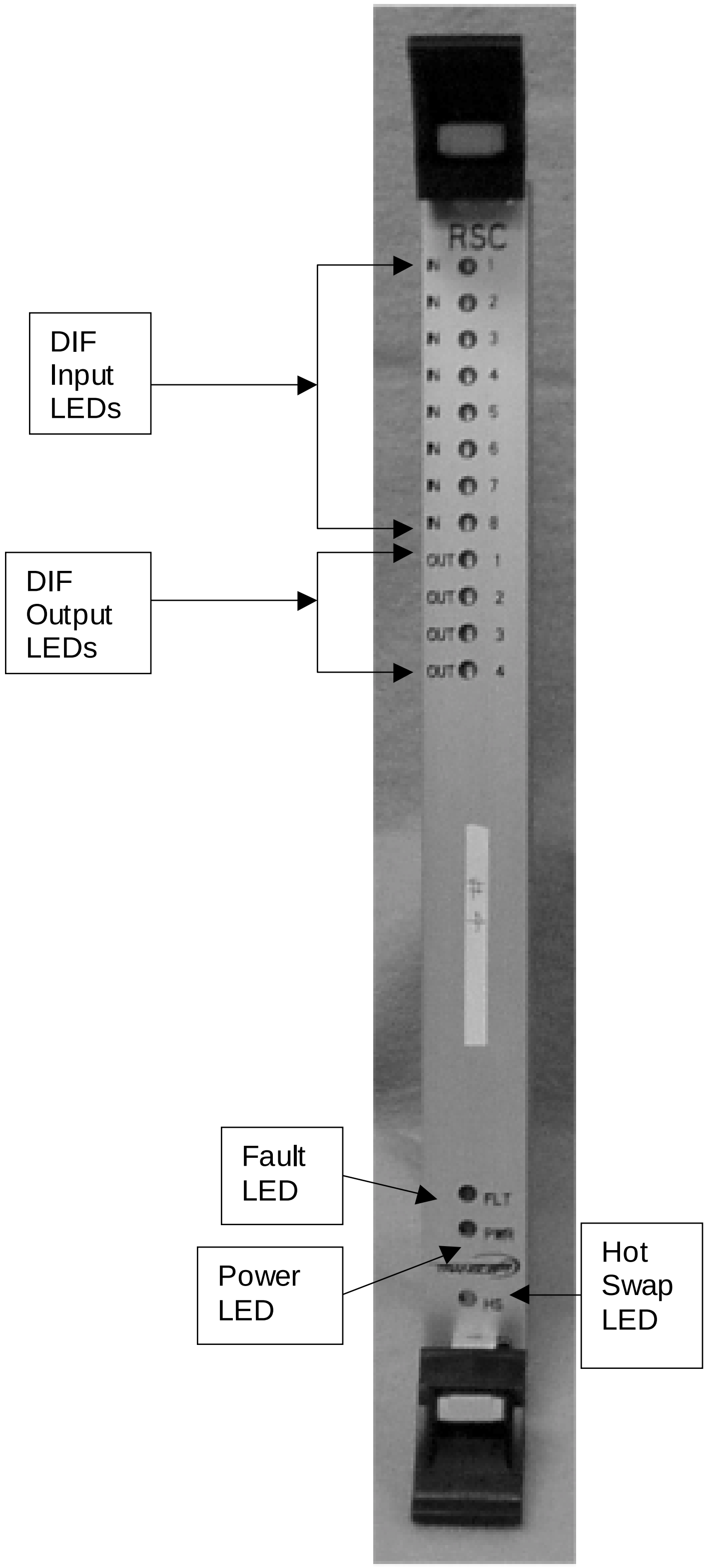

Figure 18. Reverse Simulcast Card Front Panel

3.3.5 COMPACTPCI PS

The front panel indicators for the Hub CompactPCI Power Supply are:

- Fail Good LED – Green Power LED, lighted when good
- Fault LED – Yellow LED, lighted when module has failed

Each module has its own set of LEDs. There are up to three modules per CompactPCI power supply.

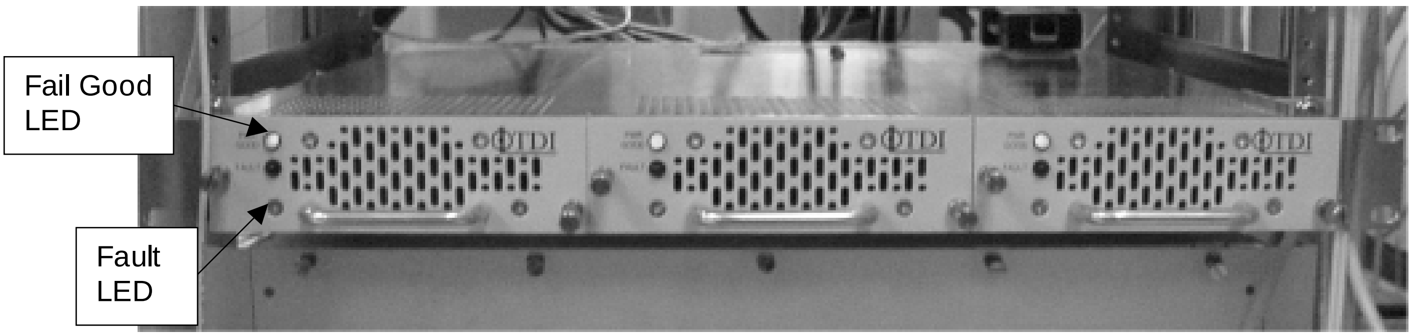

Figure 19. Hub CompactPCI Power Supply Front Panel

3.3.6 DIO

The front panel indicators for the Forward Simulcast Card are:

- REF LED – Green LED lighted when 9.6 MHz reference is present
- CLK LED – Green LED lighted when 42.912 MHz clock is present
- DIF LED 1-12 – Tri-color LEDs. Operational when used behind SIF (1-8) or RSC(1-12). Not used when behind HUC or FSC.
  - Off = No input signal
  - Green = Good
  - Yellow or Red = Bad

Figure 20. Digital I/O Front Panel

3.3.7 RFIO

The front panel indicators for the Forward Simulcast Card are:

- REF LED – Green LED lighted when 9.6 MHz reference is present
- CLK LED – Green LED lighted when 42.912 MHz clock is present
- I2C Comm LED – On each I2C RJ-45 connector. Green LED lighted when I2C message sent
- I2C Error LED – On each I2C RJ-45 connector. Red LED when no response on interface
- LED 1 & 2 – Tri-color LEDs. Reserved for future use.

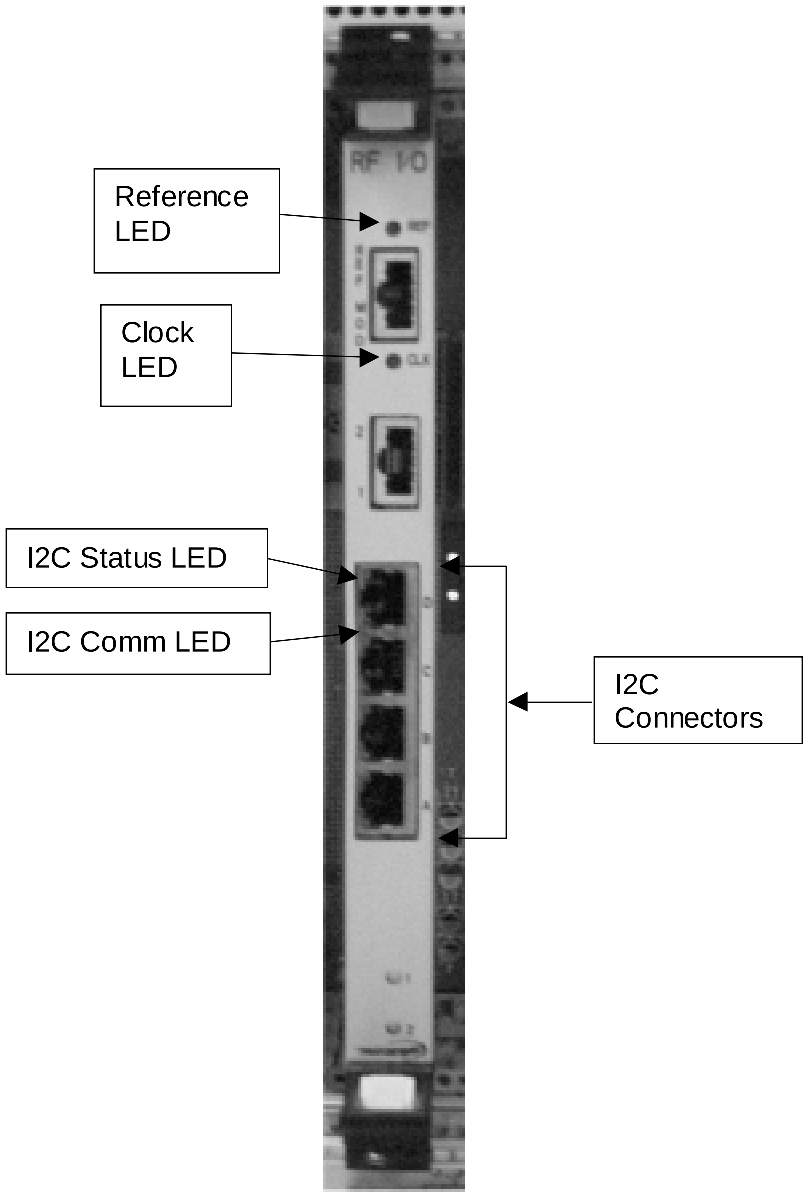

Figure 21. RF I/O Module Front Panel

3.3.8 HRM

The front panel indicators for the Hub Reference Module are:

- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power
- PLL Lock LED – Yellow LED lighted when Phase Locked Loop is locked

Figure 22. Hub Reference Module Front Panel

The rear panel indicators for the Hub Reference Module are:

- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power
- PLL Lock LED – Yellow LED lighted when Phase Locked Loop is locked
- I2C Address Display – 7 segment display showing I2C Address(0-7)

The rear panel controls for the Hub Reference Module are:

- I2C Address Selector – Rotary switch selecting I2C address 0-7

Figure 23. Hub Reference Module Front Panel

3.3.9 Ethernet Hub

The front panel indicators for the hub Reference Module are:

- Power LED – Lit when unit has power
- Module Link/Act LED – Flickering when receiving or transmitting data
- 100 Col LED – Lit when 100 Mbps collisions are occurring
- 10 Col LED –Lit when 10 Mbps collisions are occurring
- Link/Act LEDs –Lit when port is transmitting or receiving data
- 100 LEDs – Lit when operating at 100 Mbps

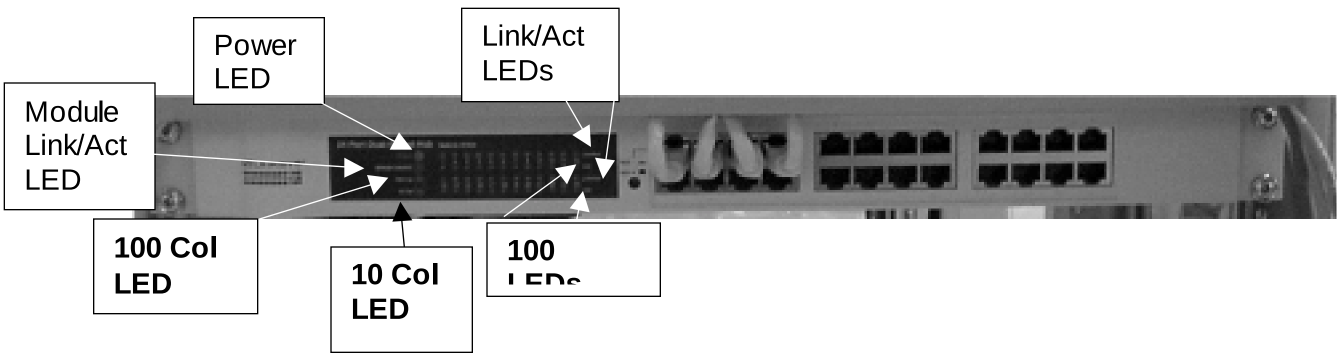

Figure 24. Ethernet Hub Converter Front Panel

3.3.10 PSI

The front panel controls for the Power Supply Interface are:

- Internal I2C address select. The default can be set to the following addresses.

The front panel indicators for the Power Supply Interface are:

- I2C Comm LED – On each I2C RJ-45 connector. Green LED lighted when I2C message sent, red LED when no response on interface
- I2C Error LED – On each I2C RJ-45 connector. Red LED when no response on interface

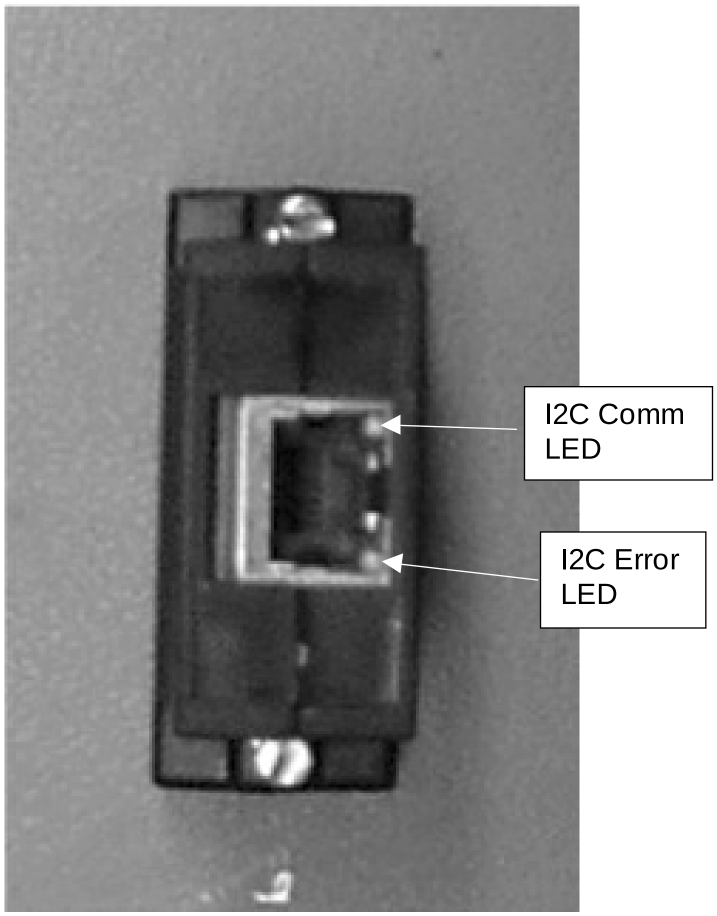

Figure 25. Power Supply Interface Front Panel

3.3.11 BIM

The front panel controls for the BTS Interface Module are:

- I2C Address selector – Turn dial to select I2C address (0-7)

The front panel indicators for the hub Reference Module are:

- FLT LED – Red LED lighted when module is failed
- PWR LED – Green LED lighted when module has power
- SMR/CELL/PCS LED – Yellow LED lighted indicating BIM band configuration
- Address display – Displays I2C address, 0-7

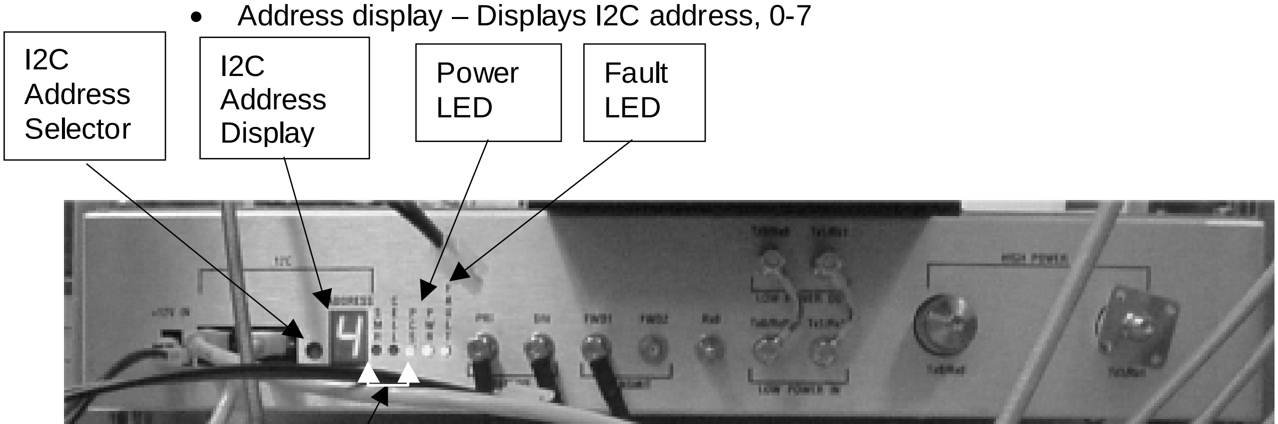

Figure 26. BTS Interface Module Front Panel

3.3.12 BIR PS

The front panel indicators for the BIR Power Supply are:

- INPUT LED – Green LED lighted when module has –48VDC input
- OUTPUT LED – Green LED lighted when module has 12VDC output

Each module (up to 3) has its own set of LEDs

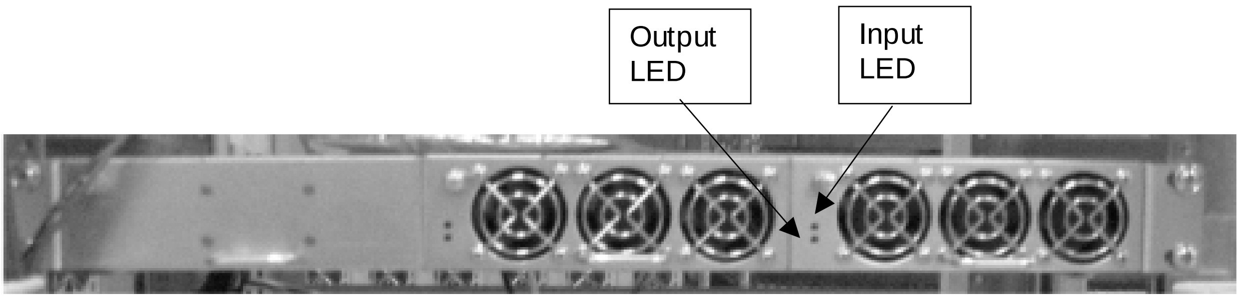

Figure 27. BTS Interface Rack Power Supply Front Panel

4.0 MIB STRUCTURE

The following shows the MIBs in the OpenCell System. These MIBs contain the interface for Monitoring and control of the OpenCell System.

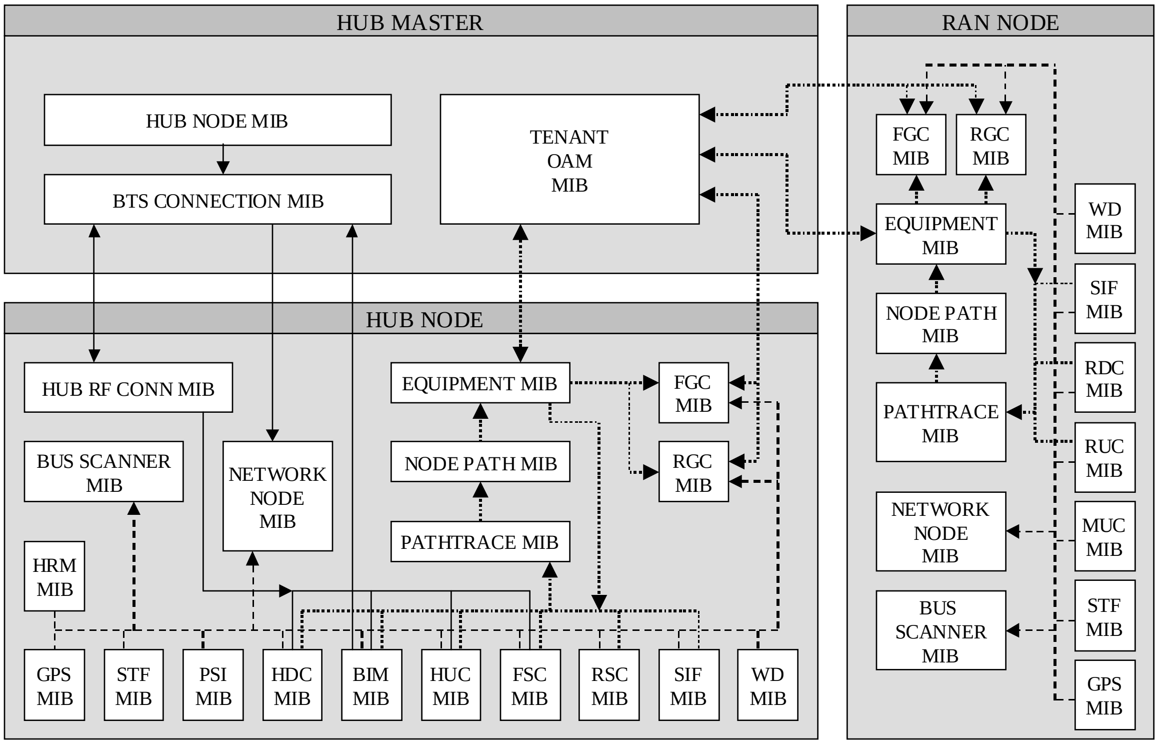

Figure 28. MIB Relationships

There are three relationship types above, represented by three line types:

- Solid lines represent the Hub Connection relationship
- Dashed lines represent the node-level hardware relationship
- Dotted lines represent the Tenant relationship

Hardware Relationships:

- The Bus Scanner MIB contains the hardware discovered at that node by the bus scanner software.
- The Network Node MIB contains status information retrieved from one or more of the HCP MIBs.
- The Network Node MIB indicates what type of node this is (Hub, RAN, or Hub Master).
- There is nothing preventing a single node (CPU) from being both a Hub Master and a “regular” Hub Node.

Hub Connection Relationships:

- The rack and chassis from the Hub Node MIB is pulled into the BTS Connection MIB by the Hub Config process.

- The Hub Config process pushes the rack and chassis information the Hub node's Network Node MIB.
- The BIM I2C Address is pulled by the Hub Config process from the BIM MIB at each Hub node into the BTS Connection MIB.
- After manual configuration in the BTS Connection MIB, the Hub Config process pushes the connection information to the Hub node's Hub RF Connection MIB.

Tenant Relationships:

- The Pathtrace process on each node pulls the pathtrace information from the relevant HCP MIBs and puts it into the Pathtrace MIB.
- Node-level Tenant processing cleans up the Pathtrace MIB information and puts it into the Node Path MIB to simplify tenant processing.
- Tenant processing in the Hub Master polls the Node Path MIB on nodes in the network for newly discovered tenants, based on new pathtrace discovery.
- Node-level tenant processing fills in the Equipment MIB based on all locally discovered hardware belonging to known tenants.
- Tenant processing in the Hub Master pushes down Tenant OAM MIB information to the Equipment MIBs on each node. The node-level Tenant processing determines if this information affects any of its hardware and makes the appropriate changes.
- Tenant processing in the Hub Master pushes down gain control information from the Tenant OAM MIB to the Forward/Reverse Gain MIBs.
- Forward and Reverse Gain processing at each node pulls from the Equipment MIB the location of its required tenant hardware modules.
- Forward and Reverse Gain processing pulls from the relevant HCP MIBs the values needed to do gain control.
- Forward and Reverse Gain processing use their own MIB (FGC and RGC) parameters, filled in by Tenant processing at the Hub Master, to determine how to operate.
- Forward and Reverse Gain processing reports results into the FGC/RGC MIB for use by Tenant processing in the Hub Master.

5.0 SETUP PROCEDURES

This section contains the information needed for setting up the hardware once the hardware has been installed and cabled.

5.1 NETWORKING

The Opencell system is a collection of network devices not unlike any other computer or printer on a network.

The Hub and Ran are the two basic network devices in the system. These devices need certain things to function in our network.

•IP address

•User Accounts

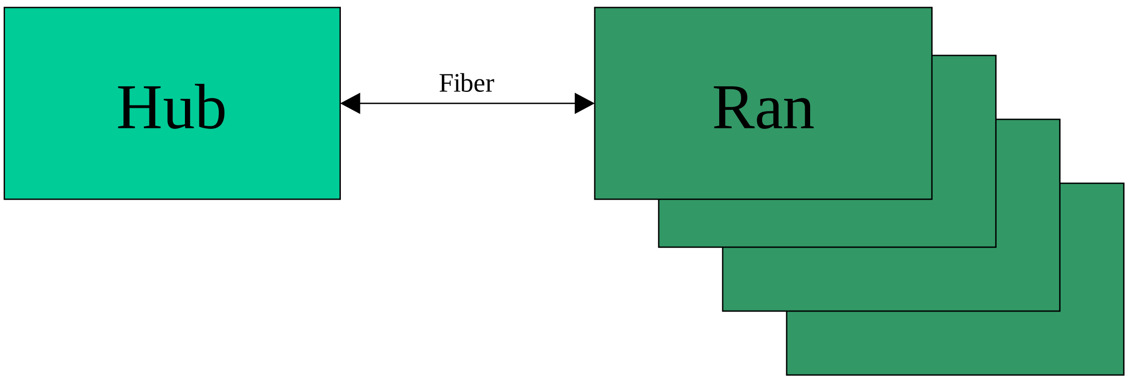

Figure 29. Hub RAN Management

IP Address: OpenCell is set up so that the Hub/Ran gets its IP through a DHCP (Dynamic Host Configuration Protocol) server. Whether Opencell provided or customer provided it does not matter where the DHCP server resides.

User Accounts: User accounts will be kept to a very small number. A root level account and a user level account. If the customer wants to create more accounts on a node for accounting purposes that will be acceptable.One problem with not having a NIS (Network Information Service) is that all account passwords are stored on the local machines. So if the customer wants to change the root password or delete a user from the system it must be done on all machines. The benefit of this system is that the machine does not need to have contact with the NIS master to validate, which makes remote operation of the machines very difficult.

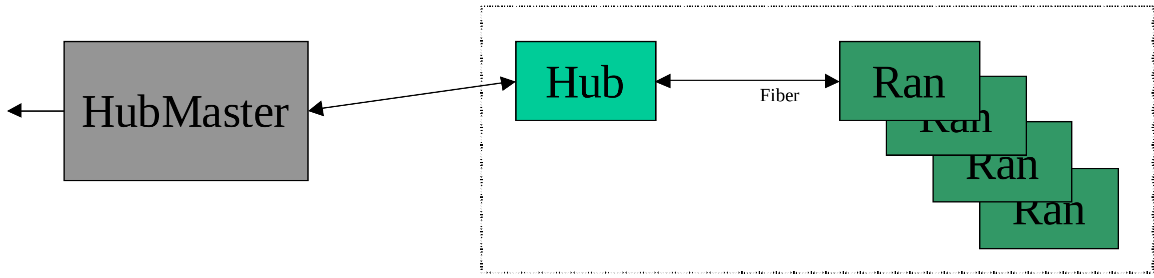

Figure 30. Hub Master Management

The HubMaster has the ability to function as a regular Hub with a few extra abilities.

- DNS (Domain Name System)
- DHCP (Dynamic Host Configuration Protocol)
- Dial
- NTP (Network Time Protocol)

On top of these the HubMaster need certain information to function

- IP Address
- User Accounts

DNS (Domain Name System): The DNS is a system that must be manually configured for each Opencell system. DNS maps the node name to an IP Address. Most importantly the HubMaster name to its IP. In order for the nodes on the system to contact and connect to the HubMaster this must be done.

DHCP (Dynamic Host Configuration Protocol): Because every node on the system needs to get an IP we have provided a DHCP server on the HubMaster. If the customer has a DHCP server already in use they can use that one and disable the one that resides on the HubMaster. Two DHCP servers can not reside on the same network without being routed appropriately. If the customers DHCP is used it must be configured to broadcast the HubMaster DNS to all nodes on that Opencell system. This allows the nodes to have access to the HubMaster.

DIAL: The Dial Utility, created at Transcept, allows the nodes to contact the HubMaster and report all vital information, namely the IP Address and Hostname of the node. Post beta Dial will dynamically update the DNS database with this information. Right now the DNS node information must be manually configured.

NTP (Network Time Protocol):

The NTP server will sync all of the nodes in its Opencell system to the HubMaster current time.

IP Address: For the HubMaster the IP Address must be statically allocated. This IP must be static because of the services it provides. It also allows us to be certain that the DNS information will always be accurate with regards to the HubMaster.

User Accounts: User accounts will be kept to a very small number. A root level account and a user level account. If the customer wants to create more accounts on a node for accounting purposes that will be acceptable. One problem with not having a NIS (Network Information Service) is that all account passwords are stored on the local machines. So if the customer wants to change the root password or delete a user from the system it must be done on all machines. The benefit of this system is that the machine does not need to have contact with the NIS master to validate, which makes remote operation of the machines very difficult.

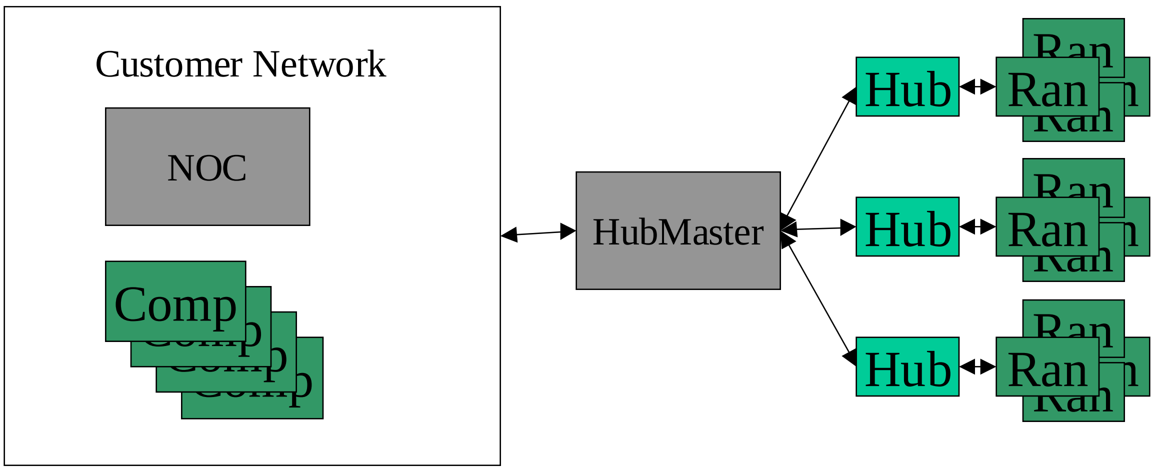

Figure 31. System Management – Single System

In the simple case of the single Opencell system the customer has several options on how to set up the system.

- If the customer has a DHCP server and wishes to not use the one provided then the DHCP on the HubMaster just needs to be disabled.
- If the customer does not have a DHCP server then the one provided will be necessary, all the customer has to do is provide a static IP for the HubMaster and a range of IP addresses for the DHCP to serve.

These are the simple cases but in each one the DHCP server must be configured to broadcast the DNS that is on the HubMaster.

- If the customer has a DHCP server already but wants to use the one that is provided by the HubMaster than a router must be brought in to separate the two DHCP servers.

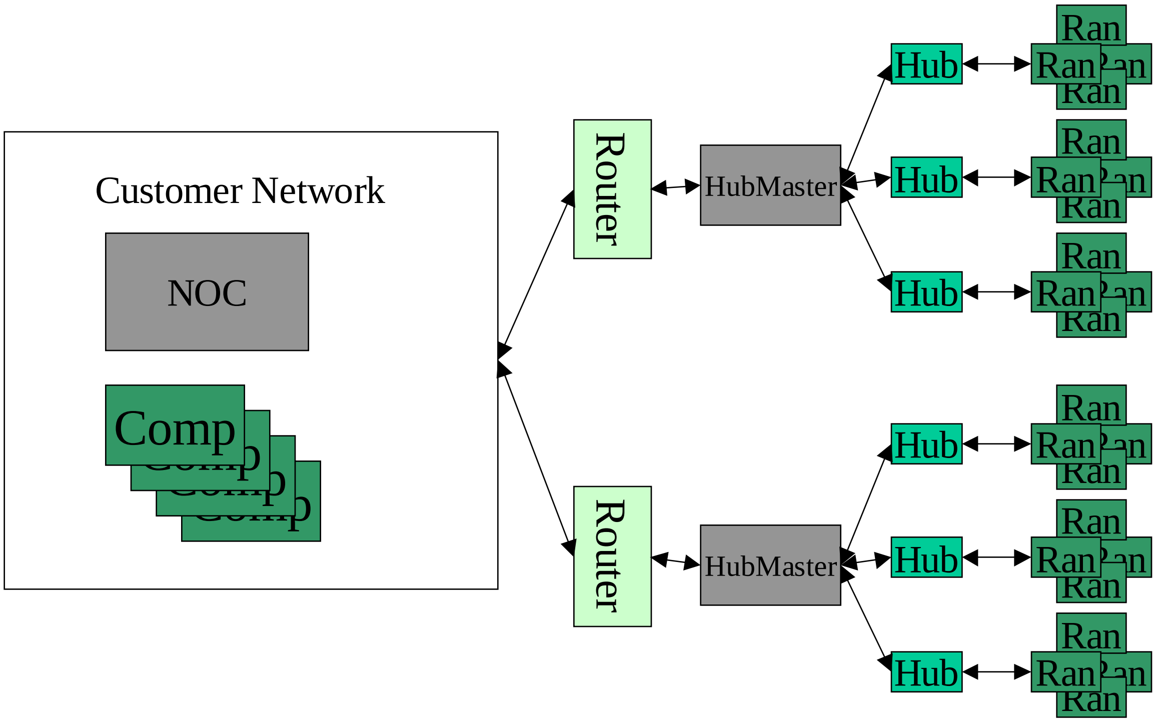

Figure 32. System Management – Multiple Systems

There can be only one HubMaster in a Opencell system. If there were two then the nodes on the system would be confused as to whom to report to. For this reason we must break the network apart into zones using routers. Configured properly the routers can be told to pass DHCP offers through which would allow the customer to use their DHCP although it would be much easier, wiser, to use the one on the HubMaster.

5.2 RAN NETWORK CONFIGURE

Identification

There are two alternatives that can be used to identify a RAN in the OpenCell network:

- Automatic: When a RAN is installed, it can be identified by its GPS coordinates. The NMS would have the responsibility of detecting the new node and naming it based on GPS coordinates.
- Manual: The installer can manually correlate the RAN MAC address with its physical pole ID. This would be done by manually updating the DNS lookup table and having the NMS correlate the pole ID with a given RAN.

The two approaches for identifying a RAN have pros and cons. Obviously, not requiring any manual configuration is attractive. However, an installer (who still needs to configure some other information) may not know the GPS coordinates of the RAN. In addition, if GPS is not available, then the lat/long coordinates would need to be manually entered.

- Each pole can support two 4-tenant RAN boxes, which need to be distinguished from one another. A convention needs to be adopted to automatically identify them. Suggestion:

- The first installed RAN box will be designated RAN Box A.
- The second installed RAN box will be designated RAN Box B.

When a box is installed on the pole, it must be tagged/labeled with its appropriate Box ID or installed in such a way that it can be identified without a label (using a known convention like top = A, bottom = B or similar).

As each RAN comes online and is detected by the NMS (by recognition of the new network node/IP address), it will be compared to see if another RAN has the same Location ID. If not it will be designated RAN Box A, and if so it will be designated RAN Box B.

If the NMS identifies a new RAN IP address at a location where in the past two RANs have already been identified, the NMS must determine which of RANs is no longer present and then assign the new RAN node the RAN Box ID of the removed RAN. This will cover the case of RAN CPUs being swapped.

The NMS will have the responsibility of creating new network node icons that correspond to each RAN CPU. The DNS name (based on location information) can be used to name these icons.

The NMS will have the addition responsibility of setting the Hub/RAN state in the Network Node MIB of the CPU to be a "RAN".

In addition, the NMS has the option of updating a RAN identification text field with some alternative location information such as street address or other customizable description.

Number of Tenants in a RAN

The RAN needs to be configured with the number of tenants to be supported. This is done by updating the appropriate parameter in the Network Node MIB of that CPU. This is required to allow certain RAN hardware to operate in the proper manner.

Please re-write or elaborate on this. Confusing as to why there is a question here. Will an installer know this information after that RAN is installed? If not, then this information will need to be configured ahead of time using a script that can be executed via a local Ethernet console session.

RF-Antenna Connections

This is really the RF PA to Multiplexer connections, more than it is the Antenna connections. Please re-write to be clearer.

The RFAntenna connections in a given RAN box need to be configured so that validation checks can be performed to be sure that signals are being properly routed. Ideally this will be configured at the customer test site or in the factory, though it could be configured after the fact by the installer via the NMS. If a pre-install method is to be supported, then the CPU will need to be locally accessed via an Ethernet console session and a script will need to be executed that will prompt the user for the connection information.

5.3 NETWORK CONFIGURE

Hub Master

- One CPU in the Hub will be designated as the Hub Master. It will run special software that does not run on all other CPUs in the OpenCell network.
- The Hub Master will be designated as such by doing a special installation of Hub Master software. The installation of this software will take care of all configuration necessary to let the CPU in question be used as a Hub Master. This includes setting a read-only state flag in the Network Node MIB of that CPU to let the NMS recognize it as a Hub Master.
- It is **absolutely critical** that only one CPU in the network be configured as a Hub Master. If the installation of Hub Master software detects that there is already a Hub Master CPU in the network, the installation will exit and indicate that the other Hub Master CPU has to have its Hub Master software uninstalled firstThe Hub Master CPU will request its IP address from the DHCP server at startup.
- The NMS will display the Hub Master network node in an easily identifiable manner (icon in the network map) so that installers can access it to aid in the configuration of other network nodes.
- The Hub Master software will periodically scan the network for the presence of all nodes (CPUs) in its own subnet (mask = 255.255.255.0) and take action as needed.

CPU Installation

- The Hub in the OpenCell network consists of several racks and chassis, which translate to several CPUs per Hub. Since these CPUs all reside at a single geographical location, it is necessary to establish a relationship of each CPU to its rack and chassis location such that field service personnel can be deployed to the correct location within the Hub when the need arises.
- There can be many CPUs at a single Hub Site within the many racks and chassis, but there is no way to correlate an IP address to its physical rack/chassis location automatically. Therefore, a convention for identifying racks and chassis needs to be established.
- Hub Racks must be given unique identifiers. This can be as simple as numbering Hub Racks from 1...N or coming up with some other naming convention. Another alternative is to come up with some sort of discrete control mechanism to let the rack IDs be set up. In any event, when a new rack is installed in the Hub, it must be labeled/tagged so a field service technician can easily identify it.
- Chassis within in a rack also need to be uniquely identifiable. The convention used should probably just be as simple as a numbering scheme where chasses are numbered from top-bottom.
- Each CPU used in the OpenCell network can be uniquely identified by the MAC address of its Ethernet controller. This MAC address should be clearly identified with a permanently fixed label on the front of the CPU module.
- The MAC-Rack/Chassis relationship will need to be manually configured. This can be done by manually editing the DNS lookup table and providing the MAC address

with a symbolic name based on rack/chassis ID. A convention should be established so that the rack/chassis can be easily parsed out by the NMS software.

- The NMS will have the responsibility of creating new network node icons that correspond to each Hub CPU. The DNS name (based on rack/chassis) can be used to name these icons.
- The NMS will need to set the Rack/Chassis ID fields of the Hub Network Node MIBs. This can be accomplished by parsing out the DNS name and doing SNMP sets to the appropriate nodes.
- The NMS will have the addition responsibility of setting the Hub/RAN state in the Network Node MIB of the CPU to be a "Hub". This is important for hardware that needs to operate differently (i.e. Sonet) depending on its node type. The NMS may do this based on the GPS coordinates of the Hub itself.

BTS-BIM Connections

- When installing Hub RF hardware, connections among the BIM, HDC, FSC, and HUC boards, as well as their association with a given tenant, need to be manually configured because there is no way for software to automatically deduce this information.
- The BTS will interface to the OpenCell network via racks containing only the BTS Interface Modules (BIMs) and their power supplies. Changes to the connections between the BTS, the BIM, and the CPU controlling the BIM will require configuration change.
- BIM modules reside in their own racks - these racks need to have a convention established to identify the BIMs within the racks. This may be as simple as numbering the BIMs from 1…M inside the rack from top to bottom and referring to the rack locations as shelves.
- When BTS-BIM-CPU connections change (because of new equipment being installed or otherwise), these changes need to be captured in a MIB that is used in the Hub Master. This MIB will establish the relationships between the BTS owners (tenant), the physical BIM locations (rack/shelf), the controlling CPU location (rack/chassis), and the BIM I2C address. The following is the proposed structure of this BIM Configuration MIB:

Tenant Name	BTS #	BTS Sector	Tenant Band	BIM Rack ID	BIM Shelf ID	BIM CPU Rack ID	BIM CPU Chassis ID	BIM I2C Bus	BIM I2C Slot

- The above MIB will be used on the Hub Master CPU. When an installer or field service technician changes the BTS-BIM-CPU configuration, that installer will access the Hub Master CPU via the NMS and update the above MIB table.

- Software that resides on the Hub Master will utilize the information in the above table to update the appropriate Network Node CPU, based on its Rack/Chassis IDs. This implies that the Hub Master software will need to determine and track the IP addresses of each Hub node and its Rack/Chassis ID.
- The Hub Master software will perform several operations:
  - o Combine the Tenant Info into a single Tenant ID String using the following format:

    <Name><:><BTS#><:><Sector><:><Band>
  - o Pass the newly formed Tenant ID string to the Hub RF Connection MIB (see next section) of the associated Hub CPU. The entry in the Hub RF Connection MIB will be determined using the BIM I2C bus/slot as the table key.
  - o Ensure that the Hub RF Connection MIB tenant information stays synchronized with the above table.

Hub RF Connections

- When a new Hub RF board (BIM, HDC, FSC, HUC) is installed or the connections among these boards are changed, the installer will make the appropriate connections and then access the appropriate node via the NMS.
- The installer will then configure the connections among the Hub RF modules in this node by updating the Hub RF Connection MIB, which will have the following format:

Tenant Info	BIM I2C Bus	BIM I2C Slot	HDC #1 I2C Bus	HDC #1 I2C Slot	HDC #2 I2C Bus	HDC #2 I2C Slot	FSC I2C Bus	FSC I2C Slot	HUC I2C Bus	HUC I2C Slot

- The tenant field in the above table will be automatically set by the Hub Master software based on the BIM I2C bus/slot, which acts as the key between the two tables.
- The table captures the connections among all of the Hub RF hardware for a given tenant sector. A configuration limitation exists which dictates that all of the RF hardware for a given tenant sector must be under the control of a single CPU. This limitation allows a maximum of 5 tenant sectors worth of RF equipment on a single CPU (a single 20 card chassis can hold 10 HDCs, 5 FSCs, and 5 HUCs in addition to the 5 BIMs needed that reside in their own rack). Once this number of tenant sectors is exceeded, a new chassis is required.
- If the above configuration limitation is seen as a problem, then the fallback solution will be to maintain a single Hub RF Connection table in the Hub Master CPU that would span all RF racks/chassis. This table would take on the same format as the one above, but would have additional fields to identify the CPU that controls each

module. This solution has pros and cons: the primary benefit would be that since all of the connection information would be on one CPU, the field service technician could access a single network node (Hub Master) to set up the entire Hub. However, doing this would make the supporting software much more complex because there would need to be many more SNMP transactions between the Hub Master software and the software within the various Hub CPUs. I would like to avoid this approach - everything from this point forward assumes that we will NOT use this solution.

RSC/SIF Configuration

- When an RSC/SIF card is installed in the Hub and/or when the cabling configuration of the RSC/SIF is changed, the RSC/SIF ports need to be enabled/disabled according to which ones have cables connected to them. The installer will access the appropriate network node (via the NMS) corresponding to the RSC/SIF rack/chassis, go to the appropriate HCP MIB, and set each of the 8 inputs to either “on” (cable connected) or “off” (no cable connected).

HRM Configuration

- No special configuration is necessary when installing HRM modules. However, the NMS may need to correlate HRM faults to the rack in which it is contained. The HRM-rack relationship can be deduced by evaluating the Rack ID of the CPU that the HRM is controlled by. This Rack ID will be contained in the Network Node MIB.

Software Operation

- The HCPs that manage the Hub Forward RF cards (BIM, HDC, FSC) will map to the above MIB table and use the tenant information to form path-trace strings that will be reported in their respective HCP MIBs. The Path Trace and Tenant HLPs will use these path-trace strings for their own specific functionality.
- The path-trace strings will take on the following format:
  <Tenant Info><,><IP Address>
  where "Tenant Info" is a formatted string created in the Hub Master (see BTS-BIM section above):
  <Name><:><BTS#><:><Sector><:><Band>
- The FSC is the starting point of the transmission of the path-trace string through the forward and reverse signal paths for the associated tenant sector. Each RF card in the chain will receive the path-trace string, report the path-trace string in its HCP MIB, and pass the path-trace string along to the next hardware module in the chain.
- The final board in the chain is the HUC, who has the added responsibility of verifying that the tenant information contained in its input path-trace string matches the tenant information in the MIB table defined above. If it does not, then the configuration is invalid and the HUC will disable its output to the BIM.

In addition, each HCP along the path-trace chain has the responsibility of verifying that its hardware module is configured to the tenant band that it receives in the path-trace string. If not, that HCP will flag a configuration error that will get reported in the Network Node MIB.

5.4 PATHTRACE

This chapter outlines the concept and usage of *pathtrace* within the OpenCell system. This chapter breaks these topics down into three (3) areas:

- Concept;
- Description of how *pathtrace* information is populated in the OpenCell MIB structure;
- Detection of a configuration fault using *pathtrace*;

5.4.1 Pathtrace Concept

Pathtrace is the term used to describe the method by which configuration thread information is stored and monitored in the OpenCell system. A properly configured OpenCell product requires that the system be aware of the specific modules that constitute each and every complete thread (both forward and reverse). Such an awareness is necessary for the following two reasons:

- ➢ Forward gain management – the system makes gain adjustments. As a consequence, the system needs to know which specific modules make up the particular forward gain thread for that tenant;
- ➢ Forward and reverse path continuity – the system needs to detect and isolate (where possible) faults in the system. As a consequence, the system needs to know which specific sequence of cascaded modules make up the forward path and the reverse path for a particular tenant;

A complete thread is composed by the serial cascaded connection of the following modules:

HUB side:	BIM, HDC, FSC, NIF, SIF (Forward path)
	SIF, NIF, RSC, HUC, BIM (Reverse path)
RAN side:	SIF, NIF, RUC, PA (Forward path)
	MCPL, RDC, NIF, SIF (Reverse path)

All modules must be functioning for the complete thread to be operational.

INSERT DIAGRAM SHOWING THE CASCADE OF MODULES HERE

5.4.2 Pathtrace MIB Information

The configuration of a particular thread is established at installation and is accomplished using the following steps:

a) Define the tenant by providing the required information to the BTS-CONNECTION-MIB;

b) View the HUB-RF-CONNECTION-MIB to ensure that all Bus/Slot information is filled in;

c) View the HUC MIB - an Invalid Configuration Fault will be set if the pathtrace algorithm detects a lack of continuity.

More information on each of the above three (3) steps is given below:

5.4.3 *TRANSCEPT-OPENCELL-BTS-CONNECTION-MIB*

The BTS Connection MIB is table-based, with 96 entries to account for the maximum amount of tenant sectors supported in the system. This MIB contains the following fields (each set per tenant sector). The four (4) fields which are highlighted below must be defined in order for the tenant to be defined.

- Tenant Info - a read-only string comprised of the tenant info from this MIB.
- ***Tenant Name - the name of the tenant***
- ***BTS ID - the ID of this tenant's basestation***
- ***BTS Sector - the sector of this tenant's basestation***
- ***Tenant Band - the band that this tenant's basestation sector uses.***
- Tenant Protocol - the protocol that this tenant's basestation sector uses.
- BIM Rack - the physical rack identification of the BIM
- BIM Shelf - the physical shelf identification of the BIM
- CPU Rack - the physical rack identification of the CPU controlling the RF equipment
- CPU Chassis - the physical chassis location of the CPU in its rack
- RF Rack - the physical rack location of the RF equipment
- RF Chassis - the physical chassis location of the RF equipment in its rack
- BIM I2C Bus/Slot - the I2C address of the BIM
- HDC1 I2C Bus/Slot - the I2C address of the first HDC
- HDC2 I2C Bus/Slot - the I2C address of the second HDC
- FSC I2C Bus/Slot - the I2C address of the FSC
- HUC I2C Bus/Slot - the I2C address of the HUC

The TRANSCEPT-OPENCELL-BTS-CONNECTION-MIB holds all of the vital configuration information about a tenant. This MIB is the link between the BTS and the rest of the system. This is accomplished by specifying the BTS information, BIM information, information about the CPU that controls this tenant's RF equipment, and the I2C addresses of this tenant's RF equipment. Since the link between the BTS, BIM and CPU cannot be auto-detected, this MIB provides the interface for setting up these relationships..

When a BIM comes online it places vital process information in the TRANSCEPT-OPENCELL-BIM-MIB. The HubConfig software continually scans for new BIMs in this MIB for each CPU. When a new BIM is discovered the HubConfig software checks to see if the BIM information and CPU information are already in the TRANSCEPT-OPENCELL-BTS-CONNECTION-MIB. The CPU information is critical since it ties us directly to the TRANSCEPT-OPENCELL-HUB-NODE-MIB and the actual physical location of the CPU and the IP address

Another key element to the TRANSCEPT-OPENCELL-BTS-CONNECTION-MIB is the HUB-RF-CONNECTION-MIB information (I2C addresses of RF equipment). Once all of this info is manually configured into the MIB, the HubConfig software pushes it all to the Hub node level based on the BIM bus/slot. This is also true for all other manually configured parameters. The BIM info is pushed down to the BIM-MIB and the tenant info is pushed down to the HUB-RF-CONNECTION-MIB.

5.4.4 TRANSCEPT-OPENCELL-HUB-RF-CONNECTION-MIB

Tenant Info	BIM I2C Bus	BIM I2C Slot	HDC #1 I2C Bus	HDC #1 I2C Slot	HDC #2 I2C Bus	HDC #2 I2C Slot	FSC I2C Bus	FSC I2C Slot	HUC I2C Bus	HUC I2C Slot

This MIB contains data critical to the successful implementation of pathtrace information. The Tenant Info string, which is a component of the pathtrace string used in the system, is coupled with the bus and slot locations of every board that requires that data.

On startup, the BIM, HDC and FSC HCPs look into this MIB to see if their particular bus and slot has been registered with any tenant. If this is the case, then these HCPs take the tenant info, form the pathtrace string from it, and transmit it through the system.

The tenant process uses these pathtrace stings to locate all hardware belonging to a particular tenant, Along with the IP, Hostname, CPU rack and CPU chassis IDs we can verify the physical locations of every board in our system through the NMS.

5.4.5 PATHTRACE FAULT DETECTION

The HUC HCP searches the MIB in much the same way to find its tenant info. It compares the tenant IDs from its primary and diversity pathtrace strings against this string to verify the path. If the HUC detects a mismatch, an "invalid configuration" fault is generated.

5.5 TENANT CONFIGURE

To configure a sector for a WSP, access the Tenant OAM MIB on the Master Hub. Via SNMPc this is accessible by right clicking on the Hub Master Node icon and selecting,

Hub Master Info

Tenant OAM Info

Tenant OAM Info

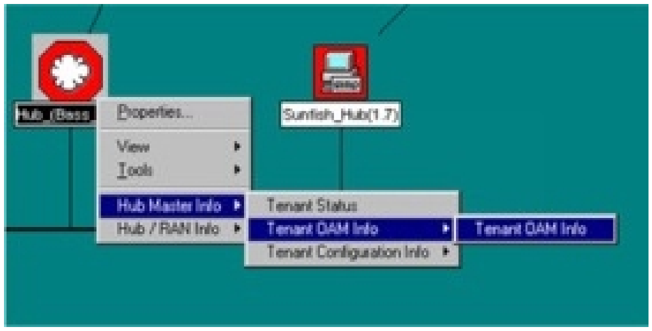

Figure 33. Tenant OAM Info Select

This MIB allows an operator to configure the following parameters:

- Channel #s
- Forward Gain
- Reverse Gain
- BTS to OpenCell cable losses
- Auto function enable/disables
    - Forward Autogain/Continuity
    - Reverse Autogain/Continuity
    - AutoDelay Compensation

Flip the display so that the sector numbers go across the top. Scroll to the desired sector number (Sectors go from 1-96).

Once changes are made the values change from blue to red. The set button must be selected for the changes to be accepted.

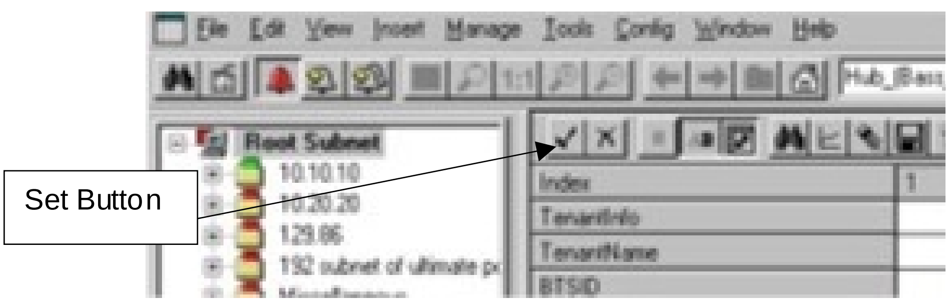

Figure 34. SNMPc Set Button

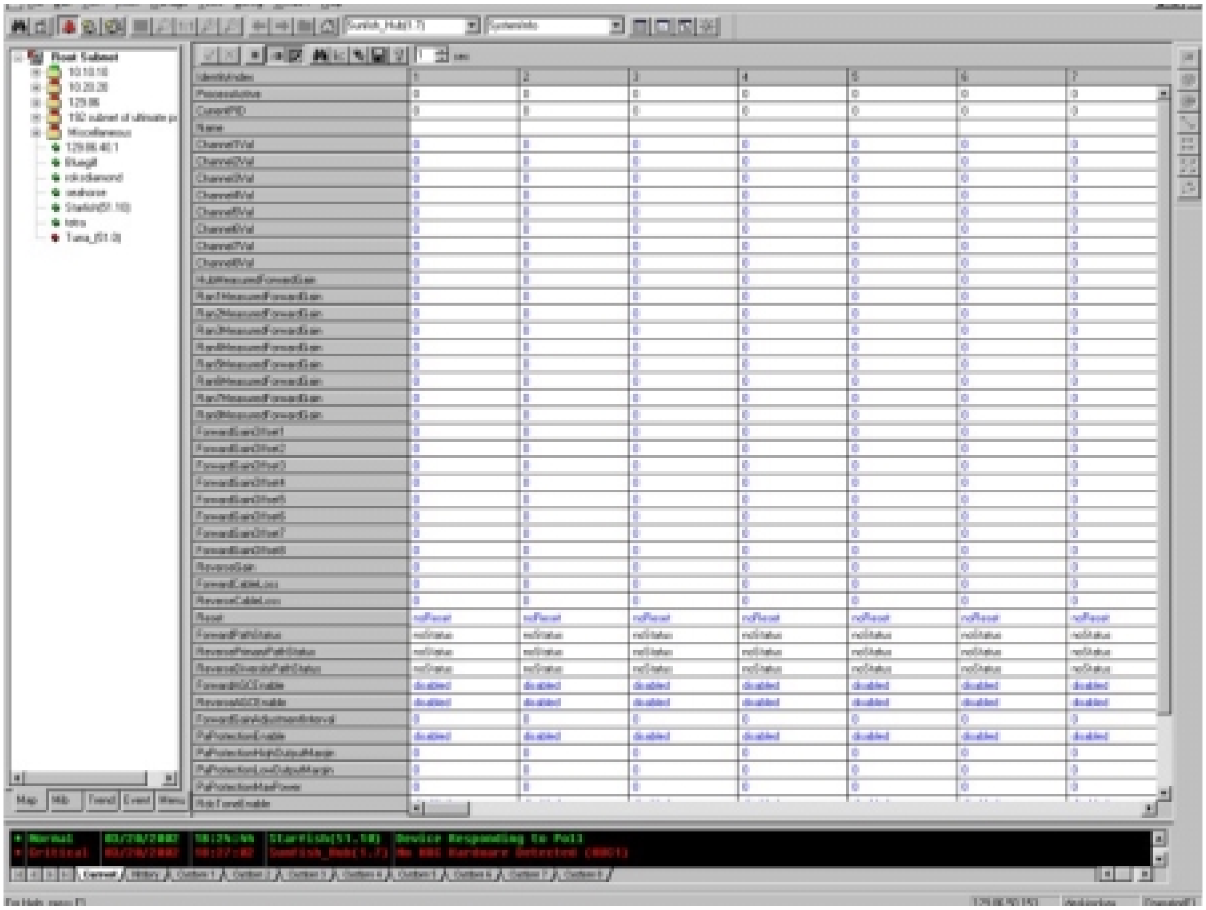

Figure 35. Tenant OAM Info MIB

Scroll to the desired sector number (Sectors go from 1-96) for entering the following information.

5.5.1 SET Channels

Enter the channel numbers in the Channel1Val-Channel8Val fields.

Channels numbers follow the standard FCC conventions for frequencies and protocols.

Note: If only a single HDC is used by this WSP, then channels 1-4 are valid. If there are two HDC's then channels 1-8 are valid.

Note: Unused channels should be set per the following table.

Table 1. Unused Channel Values

Channel	Value
1	-1
2	-2
3	-3
4	-4
5	-5
6	-6
7	-7

Channel	Value
8	-8

5.5.2 SET Forward Gain

Enter the desired gain in the ForwardGainOffset1 to ForwardGainOffset8 fields.

The gain is against the baseline OpenCell power levels. 0 dB of gain (the default) will give the nominal power per channel by protocol and frequency (first entry in each table row). The gain can be adjusted up from 0 to +8 if a WSP is using less than the baseline number of carriers and they desire more power at a selected RAN site.

Gain can also be set from –12 to 0 dB if a WSP desires less output power at selected RAN locations. The baseline powers are shown in the table below.

Typically the gains will be set to zero for all Tenants since that is when the link budgets match. Optimization a given location may require adjustment from the zero dB gain settings.

Table 2. Max. Forward Gain Settings as function of #channels

Frequency and Protocol	Output (dBm)	Max. Gains
Transmitter output power CDMA (PCS)		
3 carriers	30.5	0
1 carrier	35.0	4.5
6 carriers	27.5	-3.0
Transmitter output power GSM (PCS)		
4 carriers	30.5	0
2 carriers	33.5	3.0
8 carriers	27.5	-3.0
Transmitter output power TDMA (PCS)		
6 carriers	28.0	0
4 carriers	30.0	2.0
2 carriers	33.0	3.0
8 carriers	27.0	-1.0
Transmitter output power CDMA (Cellular/SMR)		
3 carriers	29.5	0
1 carrier	34.0	4.5
6 carrier	26.5	-3.0
Transmitter output power GSM (Cellular/SMR)		
4 carriers	29.5	0
2 carriers	32.5	3.0
8 carriers	26.5	-3.0
Transmitter output power TDMA (Cellular/SMR)		
6 carriers	27.0	0
4 carriers	29.0	2.0
2 carriers	32.0	5.0
8 carriers	26.0	-1.0
Transmitter output power IDEN (Cellular/SMR)		
6 carriers	27.0	0
4 carriers	29.0	2.0
2 carriers	32.0	5.0
8 carriers	26.0	-1.0

Note: There is 3.5 dB of loss from PA output to output of RAN for PCS, 2.5 dB in Cellular and 3.0 dB in SMR. The above output powers are denoted at the output of the RAN. The PA measured power will be higher.

5.5.3 SET Reverse Gain

Enter the desired reverse gain in the ReverseGain field.

Reverse gain indicates how much gain OpenCell will give to a reverse path signal before presenting it to the BTS (e.g. a –100 dBm signal at the RAN input will be –90 at the input to the BTS when Reverse Gain is set to 10 dB).

Table 3. Reverse Gain Settings

Reverse Gain (dB)	Comment
+10	Normal setting
0	Shared BTS tower sector, 3dB impact on BTS tower coverage
-10	Shared BTS tower sector, no impact on BTS tower coverage, 3dB impact on OpenCell coverage

5.5.4 SET Forward/Reverse Cable losses

Enter the cable loss for the forward connection cable into the ForwardCableLoss field.

Enter the cable loss for the reverse connection cable into the ReverseCableLoss field.

The cables should be swept to insure that their cable loss is correct. This allows OpenCell to accurately manage the gains in the forward and reverse directions.

5.5.5 SET Auto Functions

The following MIB values should be enabled:

- ForwardAGCEnable – Enables forward gain management
- ReverseAGCEnable – Enables reverse gain management
- DelayCompensationEnable – Enables automatic delay compensation

6.0 INTEGRATION PROCEDURES

6.1 HUB/RAN INTEGRATION

6.1.1 Forward Path Balance

In order to balance the forward path the following procedure is followed:

- Disable PA
- Inject tone into BIM at level to be received from BTS
- Measure power in OpenCell FSC on control channel
- Adjust HDC attenuator to achieve desired power level (0 dBm)
- Enable PA
- Measure output power on PA
- Adjust RUC attenuator to achieve desired output power (24-34 dBm)
- Repeat on all channels

6.1.2 Reverse Path Balance

In order to balance the reverse path the following procedure is followed:

- Measure or calculate cable loss from BIM Output to BTS input
- Enter value into Tenant MIB
- Enter reverse gain setting (-10 to +10 dB, typically +10 dBm)

7.0 BTS INTEGRATION

7.1.1 BTS Parameter Changes – TDMA

BTS/SCCS Parameter Modifications.

Manufacturer	Required Change	Parameter	Performance Problem	Req'd for OpenCell
Ericsson				
	Disable	DC Bias on BTS Rx Ports	BTS Bias Alarm	Yes
	Increase 10 dB	SSB Level (channel sealing level)	Unable to place call on sealed channel	Yes
	Increase 8 dB over BTS-only settings	SSI (Power Increase) level	Repeater/Tower handoff unbalanced	Yes
	Increase 8 dB over BTS-only settings	SSD (Power Decrease) level	Repeater/Tower handoff unbalanced	Yes
Lucent				
	Enable	Shortened Burst Mode	No calls initiated	Yes
	Change from 0 to 2.	Page 5 of FCI form, field 94	No calls initiated	Yes
	Set to 2. (Max delay setting)	If Page 5 is full, go to page 6 of FCI form, field 118	No calls initiated	Yes
	Disable	Hobbit	Intracell handoff occur	Yes
Nortel	Change from normal to ABBREV	DCCHDATA datafill FIELD 6	No calls initiated	Yes
	Disable	TLR (TDMA Locate Receiver)	No hand ins	Yes
	Change from enable to DISABLE for each sector pair, i.e. Z into X as well as X into Z.	HOPAIR datafill NBHO field	No handoffs or hand ins	Yes

7.1.2 Neighbor List Updates

During initial OpenCell installation, failed mobile hand-offs may be due to outdated or incorrect neighbor list. Because the OpenCell system has the ability to change the RF footprint of its donor base station on a sector by sector basis, the neighbor list of the donor BTS and of each adjacent BTS (based on RF footprint) will require review and updating where applicable. Without this modification, mobile handoff functionality could be degraded or even rendered inoperable. For a quick cross-check of the RAN neighbors, note DCCH channel numbers seen by a mobile as it is moved out radially from the center of the site. This list should match a network planning list of DCCH channels and sectors for adjacent BTS/SCCS installations. During this test, if the call drops due to a low DCCH level in the presence of a large alternate DCCH level, the neighbor list needs to be reviewed and where applicable updated.

There are other reasons for failed hand-offs, timers, insufficient neighbor signal quality, interference

7.1.3 BTS Validation

Prior to connecting the base station to the OpenCell Hub a full suite of BTS tests should be run to assure the BTS is operating per manufacturers specification.

7.1.4 Forward RF Path Balance

This RF path balance is from the Hub input to the RAN output.

In order to balance the forward path the following procedure is followed:

- Disable PA
- Enable channel from BTS (place call to get voice channels, certain channels may need to be blocked in order to have forward signal)
- Measure power in OpenCell FSC on control channel
- Adjust HDC attenuator to achieve desired power level (0 dBm)
- Enable PA
- Measure output power on PA
- Adjust RUC attenuator to achieve desired output power (24-34 dBm)
- Repeat on all channels

7.1.5 Reverse Path Balance

In order to balance the reverse path the following procedure is followed:

- Measure or calculate cable loss from BIM Output to BTS input
- Enter value into Tenant MIB
- Enter reverse gain setting (-10 to +10 dB, typically +10 dBm)

7.1.6 RAN Call verification

In order to balance the reverse path the following procedure is followed

- Deploy technician to RAN sites
- Place calls on all RF channels