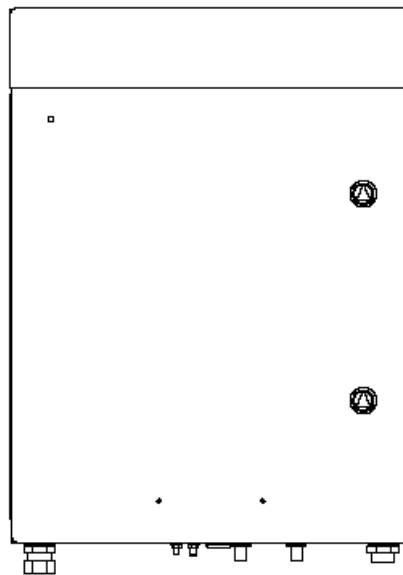
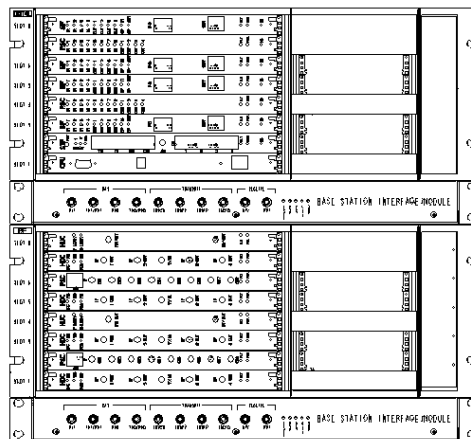




# Digivance<sup>®</sup> CXD Multi-Band Distributed Antenna System Installation and Operation Manual

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ADCP-75-192  
Preliminary Issue D  
October 2005

# **Digivance<sup>®</sup> CXD Multi-Band Distributed Antenna System Installation and Operation Manual**

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## LIST OF CHANGES

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SECTION	IDENTIFIER	DESCRIPTION OF CHANGE
-	-	Original release

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## ABOUT THIS MANUAL

This installation and operation manual provides the following information:

- An overview of the Digivance CXD system.
- A description of the basic system components including the Digital Chassis, RF Chassis, CPU, STF, HDC, HUC, SIF, FSC, RSC, cPCI Power Supplies, RAN, RDC, RUC, and LPA.
- Installation procedures for the HUB assembly.
- Procedures for tuning-up the system and verifying that the system is functioning properly.
- Procedures for maintaining the system including troubleshooting problems and replacing faulty components.
- Product warranty, repair, return, and replacement information.

The procedures for installing the remote unit and for installing and using the EMS software are provided in other publications which are referenced in the Related Publications section and at appropriate points within this manual.

## RELATED PUBLICATIONS

Listed below are related manuals and their publication numbers. Copies of these publications can be ordered by contacting the ADC Technical Assistance Center at 1-800-366-3891, extension 73476 (in U.S.A. or Canada) or 952-917-3476 (outside U.S.A. and Canada).

<b>Title/Description</b>	<b>ADCP Number</b>
<b>Digivance CXD Installation Manual</b>	<b>1001669</b>
Provides instructions for installing the CXD HUB, RAN cabinet, modules, LPA and optional battery in the remote unit cabinet and for installing and connecting the fiber optic, coaxial, and AC power cables.	
<b>Digivance CXD/NXD EMS-SNMP Manager</b>	<b>1001516</b>
Provides instructions installing the Digivance EMS and SNMP software and isolating faults and troubleshooting system performance.	
<b>Digivance CXD/NXD Hardware Configuration Manual</b>	<b>1001542</b>
Provides instructions for installing the Digivance CXD and NXD hardware.	

## ADMONISHMENTS

Important safety admonishments are used throughout this manual to warn of possible hazards to persons or equipment. An admonishment identifies a possible hazard and then explains what may happen if the hazard is not avoided. The admonishments — in the form of Dangers, Warnings, and Cautions — must be followed at all times. These warnings are flagged by use of the triangular alert icon (seen below), and are listed in descending order of severity of injury or damage and likelihood of occurrence.



**Danger:** *Danger is used to indicate the presence of a hazard that **will** cause severe personal injury, death, or substantial property damage if the hazard is not avoided.*



**Warning:** *Warning is used to indicate the presence of a hazard that **can** cause severe personal injury, death, or substantial property damage if the hazard is not avoided.*



**Caution:** *Caution is used to indicate the presence of a hazard that **will** or **can** cause minor personal injury or property damage if the hazard is not avoided.*

## GENERAL SAFETY PRECAUTIONS



**Danger:** *This equipment uses a Class 1 Laser according to FDA/CDRH rules. Laser radiation can seriously damage the retina of the eye. Do not look into the ends of any optical fiber. Do not look directly into the optical transceiver of any digital unit or exposure to laser radiation may result. An optical power meter should be used to verify active fibers. A protective cap or hood **MUST** be immediately placed over any radiating transceiver or optical fiber connector to avoid the potential of dangerous amounts of radiation exposure. This practice also prevents dirt particles from entering the adapter or connector.*



**Danger:** *Do not look into the ends of any optical fiber. Exposure to laser radiation may result. Do not assume laser power is turned-off or the fiber is disconnected at the other end.*



**Danger:** *Wet conditions increase the potential for receiving an electrical shock when installing or using electrically-powered equipment. To prevent electrical shock, never install or use electrical equipment in a wet location or during a lightning storm.*



**Warning:** *The Digital Chassis and other accessory components are powered by 48 VDC power which is supplied over customer-provided wiring. To prevent electrical shock when installing or modifying the power wiring, disconnect the wiring at the power source before working with uninsulated wires or terminals.*



**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 the antenna.*



**Caution:** *Always allow sufficient fiber length to permit routing of patch cords and pigtailed without severe bends. Fiber optic patch cords or pigtailed may be permanently damaged if bent or curved to a radius of less than 2 inches (50 mm).*



**Caution:** *Exterior surface of the RAN may be hot. Use caution during servicing.*



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

## SAFE WORKING DISTANCES

The Digivance CXD antenna, which is mounted on top of a pole, radiates radio frequency energy.

For the Occupational Worker, safe working distance from the antenna depends on the workers location with respect to the antenna and the number of wireless service providers being serviced by that antenna.

Emission limits are from OET Bulletin 65 Edition 97-01, Table 1 A.

RF fields are computed using equation 3 from the same document.

RF fields below antenna are computed using equation 10 with F=0.3.

Combining the PCS and cell bands was done in accordance with OET Bulletin 65, page 35 (last paragraph).

WORKER LOCATION	BELOW ANTENNA *	BESIDE ANTENNA
One Band	10.2"	32.3"
Two Bands	14.3"	45.3"
Three Bands		
* "Below" is defined as a 100 degree cone, 50 degrees each side of the utility pole, with the tip of the cone at the base of the antenna.		

Should the criteria for safe working distance not be met, the power amplifiers must be turned off at the site where work is to be performed prior to commencing work.

## COMPLIANCE STATEMENT

Each respective SMR, Cellular, and PCS system in this CXD platform is singularly FCC and IC approved. Information in this manual explains applicable portions of these systems.

**FCC:** This Digivance CXD complies with the applicable sections of Title 47 CFR Part 15, 22, 24 and 90.

The Digivance CXD 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.

Changes and Modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under Federal Communications Commissions rules.

In order to maintain compliance with FCC regulations shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio & television reception.

**ETL:** This equipment complies with ANSI/UL 60950-1 Information Technology Equipment. This equipment provides the degree of protection specified by IP24 as defined in IEC Publication 529. Ethernet signals not for outside plant use.

**FDA/CDRH:** This equipment uses a Class 1 LASER according to FDA/CDRH Rules. This product conforms to all applicable standards of 21 CFR Part 1040.

**IC:** This equipment complies with the applicable sections of RSS-131. The term “IC:” before the radio certification number only signifies that Industry Canada Technical Specifications were met.

## ACRONYMS AND ABBREVIATIONS

The acronyms and abbreviations used in this manual are detailed in the following list:

<b>AC</b>	Alternating Current
<b>ASCII</b>	American Standard Code for Information Interchange
<b>Att</b>	Attenuation
<b>AWG</b>	American Wire Gauge
<b>BER</b>	Bit Error Rate
<b>BTS</b>	Base Transceiver Station
<b>C</b>	Centigrade
<b>CAN</b>	Controller Area Network
<b>CDRH</b>	Center for Devices and Radiological Health

<b>CD-ROM</b>	Compact Disk Read Only Memory
<b>COM</b>	Common
<b>Config</b>	Configuration
<b>CUL</b>	Canadian Underwriters Laboratories
<b>DAS</b>	Distributed Antenna System
<b>DC</b>	Direct Current
<b>DCE</b>	Data Communications Equipment
<b>Div</b>	Diversity
<b>DTE</b>	Data Terminal Equipment
<b>EIA</b>	Electronic Industries Association
<b>EMS</b>	Element Management System
<b>ESD</b>	Electrostatic Discharge
<b>F</b>	Fahrenheit
<b>FCC</b>	Federal Communications Commission
<b>FDA</b>	Food and Drug Administration
<b>FSO</b>	Free Space Optics
<b>Fwd</b>	Forward
<b>GFC</b>	Ground Fault Circuit Interrupter
<b>GUI</b>	Graphical User Interface
<b>IC</b>	Industry Canada
<b>LED</b>	Light Emitting Diode
<b>LPA</b>	Linear Power Amplifier
<b>MHz</b>	Mega Hertz
<b>MI</b>	Maintenance Interface
<b>MPE</b>	Maximum Permissible Exposure
<b>MTBF</b>	Mean Time Between Failure
<b>NC</b>	Normally Closed
<b>NEM</b>	Network Element Manager
<b>NO</b>	Normally Open
<b>NOC</b>	Network Operations Center
<b>NPT</b>	National Pipe Tapered
<b>OSP</b>	Outside Plant
<b>PA</b>	Power Amplifier
<b>PC</b>	Personal Computer
<b>PCS</b>	Personal Communications System
<b>Prg</b>	Program
<b>Pwr</b>	Power
<b>Re</b>	Reverse
<b>RF</b>	Radio Frequency
<b>RIM</b>	Radio Interface Module
<b>RMA</b>	Return Material Authorization
<b>RU</b>	Remote Unit

<b>RX</b>	Receive or Receiver
<b>SMR</b>	Specialized Mobile Radio
<b>STM</b>	Spectrum Transport Module
<b>TX</b>	Transmit or Transmitter
<b>UL</b>	Underwriters Laboratories
<b>VAC</b>	Volts Alternating Current
<b>VDC</b>	Volts Direct Current
<b>VSWR</b>	Voltage Standing Wave Ratio
<b>WECO</b>	Western Electric Company
<b>WDM</b>	Wave Division Multiplexer

#### Common Items (HUB or RAN)

<b>CPU</b>	Central Processing Unit
<b>NMS</b>	Network Management System
<b>BTS</b>	Base TRANsceiver Station
<b>BIF</b>	Backplane Interface
<b>STF</b>	System Interface
<b>SIF</b>	Synchronous Interface (Fiber Interface also referred to as WBOT)
<b>MAC</b>	Media Access Control
<b>RAN</b>	Radio Access Node
<b>Node</b>	Any CPU in the Digivance CXD system
<b>WBDOT</b>	Wide Band Optical Transport (see SIF)

#### HUB Specific

<b>W/HDC</b>	Wideband Hub Down Converter
<b>FSC</b>	Forward Simulcast Card
<b>RSC</b>	Reverse Simulcast Card
<b>HUC</b>	Hub Up Converter
<b>BIM</b>	Base Station Interface Module
<b>HRM</b>	Hub Reference Module
<b>EHUB</b>	Ethernet Hub
<b>DNS</b>	Domain Name Service
<b>DHCP</b>	Dynamic Host Configuration Protocol
<b>PDU</b>	Power Distribution Unit

#### RAN Specific

<b>RUC</b>	RAN Up Converter (Dual)
<b>PA800</b>	Power Amplifier (800 MHz)
<b>PA1900</b>	Power Amplifier (1900 MHz)
<b>PASMR</b>	Power Amplifier (SMR)
<b>P/MCPLR</b>	PCS Multicoupler

<b>C/MCPLR</b>	Cellular Multicoupler
<b>RDC</b>	RAN Down Converter
<b>PQP</b>	PCS Quadplexer
<b>CTP</b>	Cellular Triplexer
<b>CDP</b>	Cellular Diplexer
<b>IB</b>	Internal Battery
<b>EB</b>	External Battery
<b>RPS</b>	RAN CompactPCI Power Supply
<b>LVD</b>	Low Voltage Disconnect
<b>RIC</b>	RF Assembly Interface Controller
<b>ANT</b>	Multiband Antenna
<b>RAN</b>	RAN, Tenant 1 – 3
<b>APEC</b>	AC Power Entry Card
<b>DPEC</b>	DC Power Entry Card
<b>CPCIP</b>	SCPCI Power Supply



## SECTION 1: OVERVIEW

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### 1 INTRODUCTION

This section provides basic description, application, and configuration information about the Digivance CXD. Throughout this publication, all items referenced as “accessory items” are not furnished with the basic product and must be purchased separately.

### 2 DIGIVANCE CXD SYSTEM OVERVIEW

The Digivance CXD is an RF signal transport system that provides long-range RF coverage in areas where it is impractical to place a Base Transceiver Station (BTS) at the antenna site. Digivance CXD is a multi-frequency, multi-protocol distributed antenna system, providing microcellular SMR, Cellular and PCS coverage via a distributed RF access system. High real estate costs and community restrictions on tower and equipment locations often make it difficult to install the BTS at the same location as the antenna. The Digivance CXD is designed to overcome equipment placement problems by allowing base stations to be hubbed at a central location while placing remote antennas at optimum locations with minimal real estate requirements. The Digivance CXD Hub is connected via high speed datalinks to Radio Access Nodes (RAN's) distributed over a geographical area of interest. With the Digivance CXD, RF signals can be transported to one or more remote locations to expand coverage into areas not receiving service or to extend coverage into difficult to reach areas such as canyons, tunnels, or underground roadways.

## 2.1 Basic Components

Figure 1-1 illustrates a Digivance CXD system with RAN's distributed over a desired geographical area, connected back to a group of Wireless Service Provider (WSP) base stations at a Hub locale. The illustration shows utility pole mounted RAN's, with pole top antennas. The Digivance CXD Hub Equipment is comprised of Digital and RF cPCI chassis' in a 19" rack assembly. The Digivance CXD Hub equipment provides the interconnection at the RF layer between the WSP base station sector(s) and the Digivance CXD Radio Access Nodes.

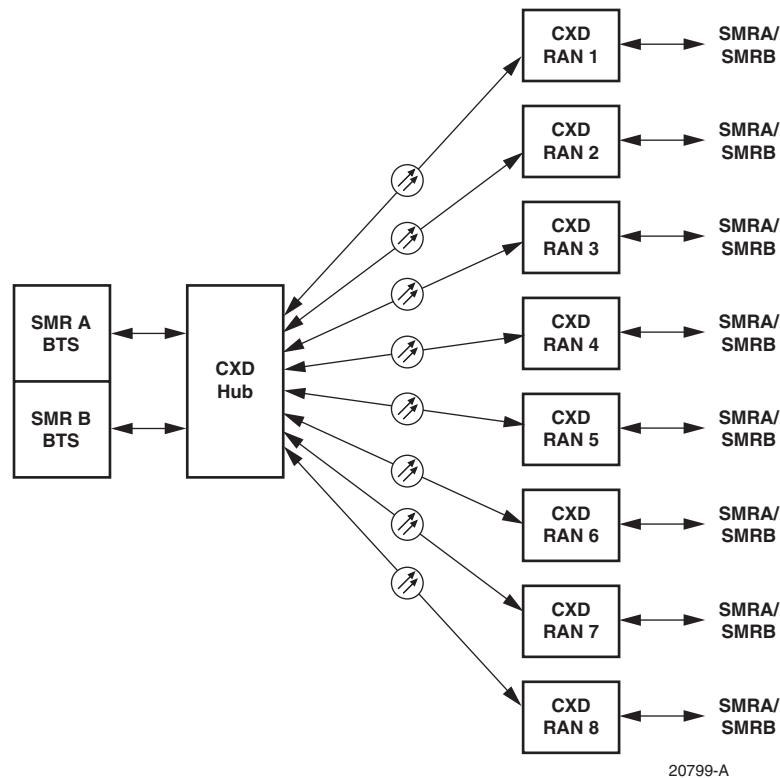


Figure 1-1. Digivance CXD Architectural Summary Diagram

## 2.2 General Description

The Hub is co-located with the BTS and interfaces directly with the BTS over coaxial cables. In the forward path, the Full Band Hub Down Converter (FBHDC) receives RF signals from the BTS and down converts the signals to IF. The Forward Simulcast Card (FSC) digitizes the RF signals and passes digital IF (DIF) signals into the Sonet Interface (SIF) that converts them to digital optical signals for transport to the RAN. At the RAN, another SIF card receives the digital optical signal, passes DIF to the Remote Up Converter (RUC) and inputs signals into a RF Assembly (RFA). The RF signals are duplexed and combined with other RF signals using a combination of either, diplexers or triplexers and then fed into a multi-band antenna.

In the reverse path, the antenna receives RF signals from a mobile and sends those signals into the RFA which contains a diplexer and Low Noise Amplifier. The output of the RFA is connected the RAN Down Converter (RDC) which down converts the RF back to IF and digitizes the signals. The DIF signals are passed to the SIF, which sends digital optical signals from the RAN to the HUB SIF. The Hub SIF combines with Dif signals from the other RANs that are in that simulcast cluster through the Reverse Simulcast Card (RSC). The Hub Up Converter (HUC) takes the RSC output and translates the digital optical signals back to RF signals for transmission to the BTS.

Figure 1-2 shows the RF signal path through the Digivance CXD system. In the forward direction, the signal starts from the base station sector on the left and moves to the right. In the reverse direction, the RF path starts at the antenna and then flows from the RAN to the Hub and to the base station sector receiver(s).

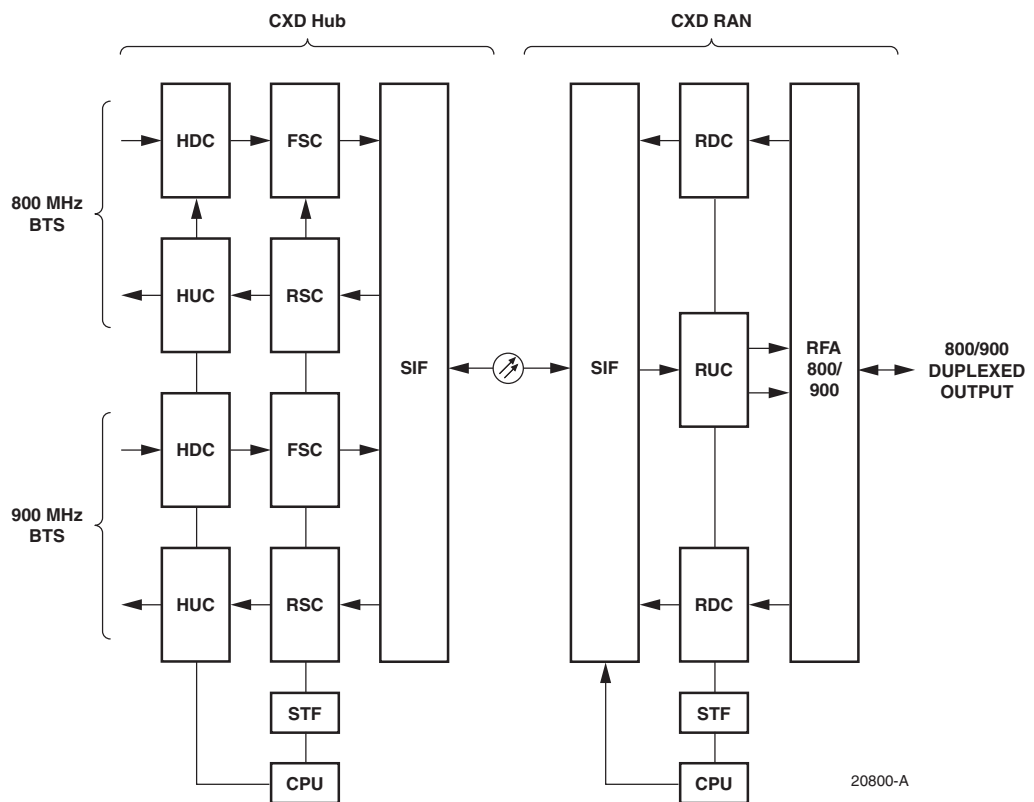


Figure 1-2. Digivance CXD Block Diagram

### 2.3 Local Service Interface

Local communications with the Digivance CXD system is supported through an IP interface capability. The Digital Chassis' and RAN Chassis' both contain CPU modules with Ethernet ports that act as nodes in an Ethernet-based network similar to that of a computer local area network (LAN). Each RAN in the Digivance network contains one CPU, while the Hub contains multiple CPUs with the Digital Chassis units depending on the number of tenant sectors supported in the system.

The Digivance CXD Element Management System is a Web based system that provides the various control and monitoring functions required for **local** management of each CXD system. The user interface into the EMS is a PC-type laptop computer loaded with a standard Web browser. The EMS is connected to the Master CPU through an Ethernet connection. Operation is effected through the EMS Graphical User Interface (GUI). The GUI consists of a series of screens from which the user selects the desired option or function. Ethernet ports are available at the Hub and RAN CPU for connecting the EMS computer at either location.

For management and operation by a customer supplied Network Management Systems (NMS) the Digivance CXD has imbedded in software a Simple Network Management Protocol (SNMP) Agent and ADC Management Information Bases (MIBs). Local communications with the Digivance CXD SNMP Agent system is supported through the IP interface at the Hub or RAN. All CPUs in the Digivance network support the SNMP to provide NMS monitoring and control access to the Digivance system. The NMS sends SNMP SET and GET messages to the various nodes in the Digivance CXD/NXD network in order to access MIB's, which define the interface to the Digivance system.

## 2.4 Remote NOC Interface

Remote communications between a Network Operations Center (NOC) and a networked grouping of multiple Digivance CXD systems is also supported by the Digivance CXD SNMP Agent. The primary component of the remote NOC interface is a PC-type desktop computer loaded with a customer supplied Network Management System (NMS). A NMS operating at a customer NOC is able to discover and manage multiple Hub and RAN sites independently or as a distributed network.

## 3 SYSTEM FUNCTIONS AND FEATURES

This section describes various system level functions and features of the Digivance CXD.

### 3.1 Fiber Optic Transport

The optical signal of a Digivance CXD is digital, the input and output RF signal levels at the HUB SIF or the RAN SIF are not dependent on the level of the optical signal or the length of the optical fiber. The maximum length of the optical fibers is dependent on the loss specifications of the optical fiber and the losses imposed by the various connectors and splices. The system provides an optical budget of **10 dB** (typical) when used with 9/125 single-mode fiber, or **22 dB** with extended optics.

The optical wavelengths used in the system are 1310 nm for the forward path and 1310 nm for the reverse path. Different wavelengths may be used for the forward and reverse paths allowing for a pair of bi-directional wavelength division multiplexers (WDM) or coarse wavelength division multiplexing (CWDM) to be used in applications where it is desirable to combine the forward path and reverse path optical signals on a single optical fiber. One WDM or CWDM multiplexer/demultiplexer module may be mounted with the Hub and the other mounted with the RAN. The WDM or CWDM passive multiplexers are available as accessory items.

## 3.2 Control and Monitoring Software

The Digivance CXD EMS or customer supplied NMS using the Digivance CXD SNMP Agent is used to provision and configure the system for operation. This includes initializing the system, setting up the Hub and RAN element identification schemes, tenant processing, setting alarm thresholds, and setting forward and reverse path RF gain adjustments. The EMS or NMS software is also used to get alarm messages (individual or summary), data measurements, or to upgrade the Hub/RAN system software. All control and monitor functions can be effected using either the EMS or through a NMS.

## 3.3 Fault Detection and Alarm Reporting

LED indicators are provided on each of the respective modules populating the Hub Digital Chassis, RF Chassis and RAN Chassis to indicate if the system is normal or if a fault is detected. In addition, a dry contact alarm interface can be provided as an accessory item that is managed by the EMS software with normally open and normally closed alarm contacts for connection to a customer-provided external alarm system. All Hub and RAN alarms can be accessed through the SNMP manager or the EMS software GUI.

## 3.4 Powering

The Hub Digital and RF Chassis are powered by  $\pm 48$  Vdc and must be hard-wired to a local office battery power source through a fuse panel.

The RAN is powered by 120 or 240 Vac (50 or 60 Hz) and must be hard-wired to the AC power source through a breaker box. The RAN is pre-wired for 120 VAC operation but can be converted to 240 VAC operation if required. On an optional basis, a back-up battery kit is available for the RAN. The battery-backup system powers the RAN if the AC power source is disconnected or fails.

### 3.4.1 HUB Power On/Off

#### Hub Power On

- Power to the Hub rack is enabled using the power system supplied by the customer located in the Hub shelter. Power to the Hub must be supplied through a fuse panel such as the 20 position ADC PowerWorx power distribution panel (available separately). The power circuit for each active element of the system must be protected with a 3 Amp GMT fuse.

#### Hub CompactPCI Chassis Power On

- Identify the power supply module for the chassis to be powered on
- Insert the power supply module(s) in the chassis

### **Hub Power Off**

- Power to the Hub racks is disabled at the power system supplied by the customer.

### **Hub CompactPCI Chassis Power Off**

- Identify the power supply module for the chassis to be powered off
- Extract the power supply module(s) from the chassis

### **3.4.2 RAN Power on/off**

#### **RAN Equipment Power On**

- Plug the AC line cord into the receptacle located between the cPCI power supplies.
- Turn power on at the customer supplied load center located on the utility pole.

#### **RAN Equipment Power Off**

- Turn the circuit breaker off at the customer supplied load center located on the utility pole.
- Unplug the AC line cord from the receptacle located between the cPCI power supplies.

## **3.5 Equipment Mounting and Configuration**

The Digital and RF Chassis are designed for mounting in a **non-condensing indoor** environment such as inside a wiring closet or within an environmentally-controlled cabinet. The Hub equipment are intended for rack-mount applications and may be mounted in either a 19- or 23-inch WEKO or EIA equipment rack, usually within 20 feet of the BTS. The RAN is designed for mounting in either an **indoor or outdoor** environment.

## **3.6 RAN Subsystem Assemblies**

The Digivance CXD RAN consists of a cabinet, RAN Chassis and backplane, a Central Processing Unit (CPU), a System Interface (STF), a Sonet Interface (SIF), RAN Down Converter (RDC), RAN Up Converter (RUC), AC Power Entry Card (APEC) or DC Power Entry Card (DPEC), and the RF Assembly consisting of Power Amplifiers, duplexers, and RF Assembly Interface Controller (RIC). Slots within the RAN Chassis are designated for particular modules.

The Digivance CXD cabinet houses the RAN components and can be mounted from a flat-vertical surface or from a utility pole using an accessory pole-mount kit. Within the enclosure space is provided for storing short lengths of excess fiber slack.

### **3.6.1 Central Processing Unit (CPU)**

The RAN has a cPCI based single-board computer with a Central Processing Unit (CPU) operating LINUX. RAN CPU:

1. Manages all RAN hardware including RF and Digital equipment
2. Manages gain & delays
3. Monitors signal presence and quality

### **3.6.2 System Interface (STF)**

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

### **3.6.3 Sonet Interface (SIF)**

The Sonet Interface module provides the fiber interface between the Hub and RAN's. This interface includes:

1. Digitized RF Signal information
2. 10 BaseT Ethernet for command and control between Hub and the RAN's.

### **3.6.4 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.

### **3.6.5 RAN Up Converter (RUC)**

The RAN Up Converter converts digitized IF into SMR frequency bands. Each RUC supports two simultaneous bands via wideband outputs. The RUC also provides clocking for its neighboring RDC's as well as extends an I2C interface to its respective RFA.

### **3.6.6 RAN Chassis & Backplane**

The RAN chassis is a six slot 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.

### **3.6.7 AC Power Entry Card (APEC)**

The APEC distributes AC power to the cPCI power supplies in the RAN. Its input range is 100 to 260 VAC. It has a built in EMI filter, fuse holder and off/on switch.

### **3.6.8 DC Power Entry Card (DPEC)**

The DPEC is used to distribute DC power to the cPCI power supplies in the RAN and is used when the battery backup option is used.

### **3.6.9 CompactPCI RAN Power Supply (RPS)**

The CompactPCI (cPCI) Power Supplies provide +/-12V, 5V and 3.3 V DC power to the cPCI backplane for use by the RAN modules. These units are hot swappable and can be redundant when used in pairs.

### **3.6.10 RF Assembly**

The RF Assembly (RFA) consists of the Power Amplifier (PA), A/C Power Supply (ies), Fans, duplexers and RF assembly Interface Controller (RIC). the dual-band 800/900 RF assembly does both SMR800 and 900 bands.

### **3.6.11 Fuses**

There are fuses in the APEC and DPEC that protect the RAN electronics:

### **3.6.12 Internal Battery backup (BAT1) 1 Hour**

The Digivance CXD has an option for an internal battery back up is located inside the CXD RAN cabinet. It is positioned in the space of a RFA and is used to provide short duration power backup to the RAN. A cabinet using the internal battery backup option can only support one single- or dual-band RFA. .

### **3.6.13 Extended Internal Battery Backup (BAT2) 2 Hour**

The Digivance CXD has an option for an extended internal battery backup option through use of a custom cabinet with an auxiliary space for the battery module. A cabinet using the extended backup option can support two single- or dual-RFA's and can provide up to two hours of battery backup time.

### **3.6.14 Antenna (ANT)**

The Digivance CXD RAN may be deployed and installed on a power distribution pole, on a building wall, on a water tank, or on a rooftop, or within a building environment. ADC can supply a number of antenna options for the Digivance CXD as accessory items. Antenna(s) may be mounted on a facade, supporting member, wall or rooftop pedestal mount. Installations may use conventional omni-directional or directional antenna, in either a sector or quasi-omni antenna configuration, depending on the site's coverage objective and design. When designing a network, the azimuth and elevation beamwidths would be selected by the RF designer to



support the desired coverage objectives. Proper antenna selection and the mounting installation is the responsibility of the customer.

When using customer supplied antenna, they should meet or exceed the following antenna specifications:

- VSWR (all bands): 1.5:1 typ, 1.65:1 max
- Maximum power input: 200W (average) 1000W (peak)
- Passive Intermodulation Distortion: -153dBc (maximum)

### 3.7 HUB Subsystem Assemblies

The Hub is comprised of a single rack assembly with two chassis types. The Hub rack houses the following modules:

1. The Digital Chassis houses the following modules:
  - CPU (Master or Slave)
  - System Interface card (STF2)
  - Sonet Interface (SIF)
  - Reverse Simulcast card (RSC)
  - CompactPCI Power Supply (CPS)
2. The RF Chassis houses the following modules;
  - Hub DownConverter card (HDC)
  - Hub UpConverter card (HUC)
  - Forward Simulcast card (FSC)
  - CompactPCI Power Supply (CPS)
3. Attenuator Rack which houses up to twelve (12) attenuators.
4. Base Station Interface Module (BIM). The BIM is a multi-port transition module used to interface with the Tenant's base station sector. The BIM accepts either duplexed or non-duplexed RF from the base station sector and provides the Digivance CXD-Hub RF section separate transmit and receive paths.
5. Ethernet hub with twenty four (24) ports.
  - 48 VDC Power Distribution Unit.
6. Hub Reference Module.

The Attenuator Rack, BIM, Ethernet Hub and Reference Module are sold as accessory items. The functionality of each of these card assemblies is defined in the following section.

### **3.7.1 Digital CompactPCI Chassis & Backplane**

The CompactPCI Digital Chassis houses cooling fans, the CPU, System Interface Module, Sonet Interface Module, Reverse Simulcast Module and power supplies. The backplane provides the distribution for clock, communication, control data and timing.

### **3.7.2 RF CompactPCI Chassis & Backplane**

The CompactPCI RF Chassis houses the cooling fans, RF transceiver modules, HUC, HDC, FSC Modules and the power supplies. 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.

### **3.7.3 Central Processing Unit (CPU)**

The Hub CPU is a cPCI single board computer with hot swap capabilities. The Operating System of the Digivance CXD uses LINUX. A Hub CPU performs the following functions:

1. Manages a subset of Hub hardware including RF and Digital equipment
2. Manages RANs connected to its Hub managed hardware.

One of the Hub CPUs must be configured as the Master Hub processor. In addition to its regular Hub CPU duties it is responsible for:

1. Reporting Tenant status
2. Controlling all Tenant specific functions
3. Synchronizing the date for all attached nodes
4. Managing gain & delays
5. Monitoring signal presence and quality
6. Managing network services such as DHCP and DNS

There is one CPU per digital chassis.

### **3.7.4 System Interface (STF2)**

The System Interface (STF2) module, using four I2C busses, provides the ability to communicate between the CPU and other modules. The STF2 also communicates with the GPS modules found both in the Master Hub Reference Module and internal to the RAN STF2. In the HUB, the STF2 communicates with chassis fans for monitoring purposes.

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

### **3.7.5 Sonet Interface (SIF)**

The Sonet Interface module provides the fiber interface between the Hub and RAN's. This interface includes:

1. Digitized RF Signal information
2. 10BaseT Ethernet for command and control between Hub and the RAN's.

### **3.7.6 Hub Down Converter (HDC)**

The HDC down converts the forward RF carrier to an intermediate frequency (IF) that can be digitized. Each HDC can support up to four separate RF carriers. A second HDC may be installed to support 5 - 8 RF channels.

### **3.7.7 Forward Simulcast Card (FSC)**

The Forward Simulcast card converts the IF signals from the HDC to Digitized IF(DIF) format. There are eight (8) separate analog-to-digital conversion circuits on one (1) FSC.

### **3.7.8 Reverse Simulcast Card (RSC)**

The RSC sums the Digital IF (DIF) from up to eight (8) RAN's into a single DIF signal that is sent to the appropriate HUC for up conversion to RF.

### **3.7.9 Hub Up Converter (HUC)**

The HUC accepts two (2) Digital IF (DIF) signals from a SIF or RSC. The two (2) DIF signals are converted from digital-to-analog and provided as two (2) separate RF signals (primary and diversity) to the BIM and BTS.

### **3.7.10 Base Station Interface Module (BIM)**

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

1. Interface to a low power forward BTS RF path
2. Handles duplexed and non-duplexed signals
3. Gain adjust for optional reverse path configurations

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

### **3.7.11 Hub Reference Module (HRM)**

The HRM generates the RF reference and fiber clocking for distribution within the Hub. In addition, it contains a GPS that generates a 1 PPS (one pulse per second) for distribution to the Digital Chassis modules for delay management.

### **3.7.12 Ethernet Hub**

Each Hub rack is equipped with a 24 port Ethernet Hub, at the top of the rack, below the HRM. It is powered by 120 VAC. An optional –48 VDC can be chosen. The Ethernet Hub is used to connect RAN CPU's (through Hub SIF's) and Hub CPU's to and existing LAN/WAN and to each other.

## **3.8 Communication Interfaces**

### **3.8.1 I2C**

I2C is a bi-directional serial bus that provides a simple, efficient method of data exchange between devices. It is used for the 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, P/MCPLR, C/MCPLR

### **3.8.2 Network Interface**

The Hub Master CPU's are able to communicate to any other CPU in the Digivance CXD system (Hub and RAN) over an Ethernet LAN using the IP based Simple Network Management Protocol (SNMP). Ethernet connections are aggregated with each rack via an Ethernet Hub. Inter-rack communication is done by connecting the Ethernet Hubs between racks.

Each SIF has a 10BaseT Ethernet connection. The Hub Master CPUs are able to communicate with the RAN's over this Ethernet connection.

### **3.8.3 SNMP**

The ADC Digivance Simple Network Management Protocol (SNMP) Agent and the ADC Management Information Bases (MIBs) provide the interface into the Digivance CXD system. A MIB is a database where scalar or tabular data "objects" known to both agent and the manager are defined and stored. The MIBs define a set of parameters with specific characteristics, including name, data type, value range, description, and read-write accessibility. An SNMP manager sends SNMP SET and GET messages to the various nodes in the Digivance CXD network in order to access MIB's.

The MIBs are compiled into a SNMP Manager as well as the Digivance CXD SNMP Agent so that both manager and agent software can communicate. Agent and manager each have their own copy of the MIB. Using the SNMP interface, the manager issues GET and SET commands for object attributes stored in the agent MIB. In addition, the manager receives unsolicited object attributes in the form of TRAP notices sent by the agent. The Digivance software has the ability to send SNMP TRAPS when certain MIB conditions are detected, reducing the amount of polling via SNMP GET requests from the SNMP manager.

## SECTION 2: DESCRIPTION

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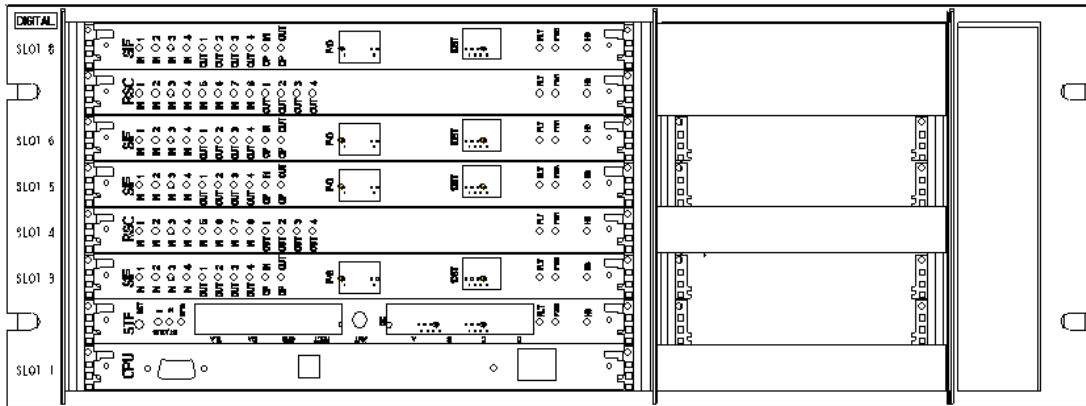
### 1 INTRODUCTION

This section describes the basic components of the Digivance CXD system including the Hub and Remote Access Node (RAN) equipment. The Hub equipment consists of the Central Processing Unit (CPU), the System Interface (STF), the Sonet Interface (SIF), the Full Band Hub Down Converter (FBHDC), the Hub Up Converter (HUC), the Forward Simulcast Card (FSC) and the Reverse Simulcast Card (RSC).

The RAN is an assembly that consists of the RAN equipment including the RAN Chassis, CPU, STF, RAN Down Converter (RDC), RAN Up Converter (RUC), and RF Assembly (RFA).

#### 1.1 Digital Chassis

The Digital Chassis, shown in Figure 2-1, is a rack-mounted chassis (known as the digital shelf) capable of housing 8 industry standard cPCI circuit card modules; one CPU module, one System Interface module (STF), and Six RSC/SIF digital modules.



**Figure 2-1. Digital Chassis**

The following is specified per the Digivance CXD system configuration:

- Sonet Interface Module
- Systems Interface Module
- Reverse Simulcast Module
- Master Processor Module
- Slave Processor Module

The quantity for each module is determined by the tenant network configuration. Note that each card slot is not equivalent, thus requiring certain modules to be specifically located within the chassis. Labeling is provided on the chassis for correct installation of the modules.

Selection of the modules for this chassis and the Digital Chassis itself should be done in accordance with Table 2-1.

**Table 2-1. Digital Chassis Module Selection Rules**

ITEM	NOTES
Sonet Interface (SIF)	1 per RAN, plus one for each additional pair of tenants in each RAN (beyond the first pair).
System Interface Module (STF)	1 STF per 2 chassis (digital and/or RF)
Reverse Simulcast Module (RSC)	One per tenant per sector per; RANs 1-4, 5-7,8. For example: with (8) RANs there are (3) RSCs
Master Processor Module (CPU)	One for every grouping of six (or less) SIF & RSC modules. Master is the first CPU
Slave Processor Module (CPU) t	One for every grouping of six (or less) SIF & RSC modules. Slave is any additional CPUs
Digital Chassis (Digital Shelf)	Holds up to 8 digital chassis modules

## 1.2 RF Chassis

The RF Chassis, shown in Figure 2-2, is a rack-mounted chassis that can house up to 8 industry standard cPCI circuit card modules (non-CPU only). Modules may be extracted by pushing outward on the extractor release buttons and then withdrawing the module from the chassis. They are inserted by aligning the module into the desired slot and then pressing inward on the extractor button until the module is securely seated.

For the RF Chassis, the customer is required to specify various modules as required:

- Forward Simulcast Module
- Hub Up Converter (HUC)
- Full Band Hub Down Converter (FBHDC)

Modules must be installed into specific slots of the chassis. The RF chassis can host up to two WSP tenant-sectors.

Selection of the modules for this chassis, and the selection of the RF Chassis itself, should be done in the following sequence and according to the rules shown in Table 2-2.

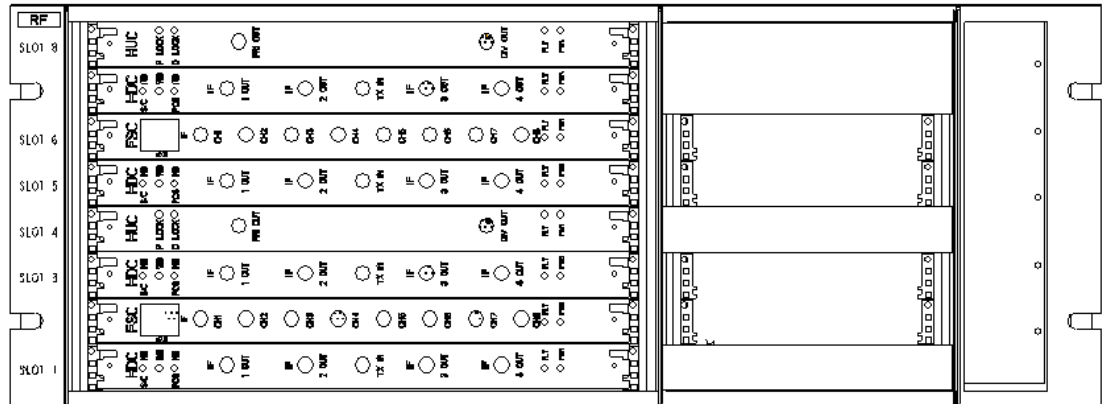


Figure 2-2. RF Chassis

Table 2-2. RF Chassis Selection Rules

ITEM	NOTES
Forward Simulcast Module (FSC)	One per sector per tenant per up to 8 RAN's
Hub Up Converter (HUC)	1 per tenant per sector.
Hub Full Band Down Converter (FBHDC)	1 per tenant per sector.
RF Chassis (RF Shelf)	Houses up to 2 tenant sectors

Connection of power is described per wiring diagram. Air baffles are inserted into unused slots. Modules are extracted by pushing outward on the extractor release buttons and drawing the module out of chassis. They are inserted by aligning the module into desired slot and pressing inward on the extractor button until the module is securely seated. Refer to Table 2-3 for slot assignments. Slots 1 – 4 are for tenant sector 1/3 and slots 5 – 8 are for tenant sector 2/4.

**Table 2-3. RF Chassis Slot Assignments**

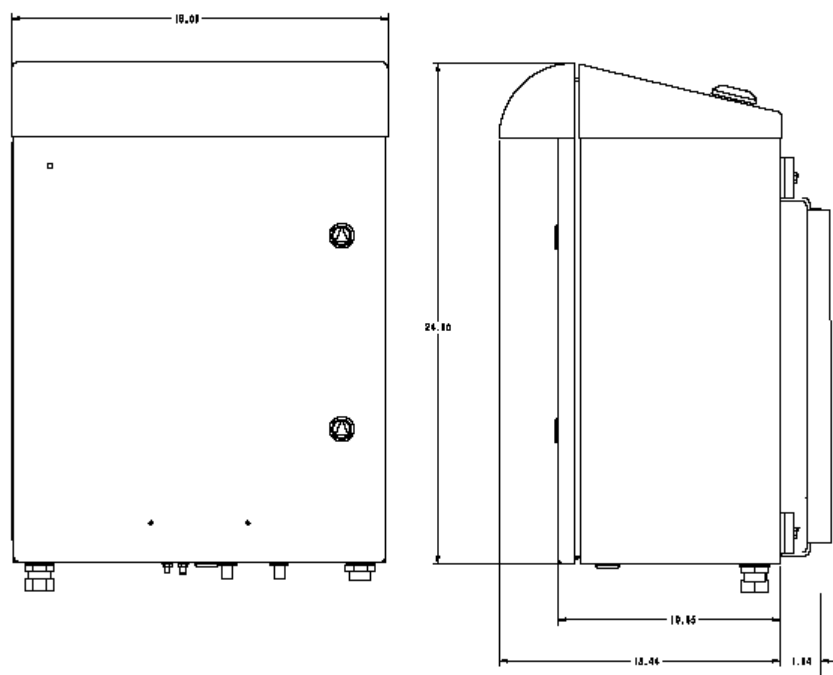
SLOT	MODULE
8	FBHDC
7	FSC
6	
5	HUC
4	FBHDC
3	FSC
2	
1	HUC

### 1.3 Radio Access Node (RAN)

The RAN cabinet, shown in Figure 2-3, is a NEMA-3R enclosure (with removable dust filter) that provides the following basic functions:

- Houses the various electronic modules including
  - RAN Chassis and Backplane
  - Central Processing Unit (CPU)
  - System Interface (STF)
  - Sonet Interface (SIF)
  - RAN Down Converter (RDC)
  - RAN Up Converter (RUC)
  - AC Power Entry Card (APEC)
  - DC Power Entry Card (DPEC)
  - RF Assembly (RFA) consisting of Power Amplifiers, duplexers, and RF Assembly Interface Controller (RIC).
- Houses accessory items such as back-up battery and WDM modules
- Protects all modules from the weather.
- Provides electrical interface connections for the RAN Chassis and RFA modules.
- Provides ventilation openings to allow the entry of cool air and the escape of heated air.





**Figure 2-3. CXD RAN Cabinet**

- Provides a point for terminating the coaxial antenna cable, the fiber optic cable, the AC power cable, and ground cable.
- Provides AC power surge protection
- Provides lightning protection
- Provides limited storage for fiber optic pigtails.

The RAN cabinet is weather-tight but contact with salt-air mist should be avoided as it may degrade the MTBF of the product. The cabinet can be mounted from a flat-vertical surface or from a utility pole (requires pole-mount kit). Slots within the RAN Chassis are designated for particular modules.

## 2 ELEMENTS COMMON TO HUB AND RAN

This section describes the various modules, controls and indicators that are common between the Hub and RAN.

### 2.1 CPU

The Hub CPU installs into the Digital Chassis and is a cPCI single board computer running LINUX. The Hub Master CPU performs the Master Hub Process controlling all Tenant specific functions, and manages a subset of Hub hardware including RF and Digital equipment. Each CPU controls up to seven (7) non-CPU Digital Chassis modules.

The front panel controls for the CPU are:

- **Reset** – Recessed reset button

The front panel indicators for the CPU are:

- **Activity LED's** – 8 Yellow LED's flashing when the OS is operating

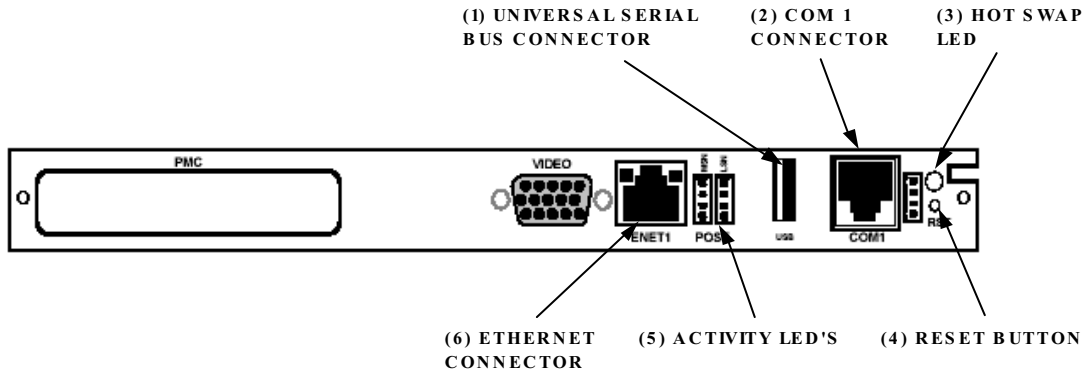


Figure 2-4. CPU Front Panel

Table 2-4. CPU User Interface

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Universal Serial Bus Connector	USB connector	Front panel Input/Output for IP connectivity.
2	COM 1 Connector	RJ-11C connector	Front panel interface for COM1.
3	Hot Swap LED	Single-colored LED (Blue)	Status indicator turns blue when board can be hot swap extracted. (not used in CXD)
4	Reset Button	Recessed switch	Used to manual reset CPU.
5	Activity LED's	Single-colored LED (Amber)	Eight LEDs give status of CPU during initial boot process and four status LEDs for board operation status.
6	Ethernet Connector	RJ-45 connector and single-colored LED (Green and Yellow)	Ethernet connector, 10 BaseT connection status and port activity status indicators
7	Video Connector	15-PIN VGA connector	Not used by Digivance CXD system

## 2.2 STF2

The System Interface (STF2) module is installed into the Digital Chassis and provides the ability to communicate between the CPU and other modules (e.g., HDC, FSC, and HUC), using four I2C busses. The STF also communicates with the GPS module found in the Master Hub Reference Module.

STF modules are specified according to the number of qualifying communications devices being utilized. This module differs from the RAN STF2 in that it does not contain the GPS circuitry included in the RAN STF2.

The front panel controls for the System Interface are:

- **RST** – Reset switch, recessed button. This button halts operation of the operating system. A power on reset is required to restart.

The front panel indicators for the System Interface are:

- **Status LED 1/2** – Yellow LED. Reserved for future use. Both LED's will be lighted when the CPU is not installed or has malfunctioned
- **GPS LED** – Green LED indicating 1PPS signal is available. Led toggles once per second (RAN only)
- **FLT LED** – Red LED lighted when module has failed or upon startup until the module has been initialized
- **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
- **I2C Error LED** – On each I2C RJ-45 connector. Red LED when no response on interface
- **HS LED** – Hot Swap LED, turns blue when board can be hot swap extracted (not used in CXD)

The STF2 has jumpers JP-7 and JP-8. JP-7 is jumpered when using CPU Part Number 1001491G002. JP-8 is jumpered when using CPU Part Number 1001310G002

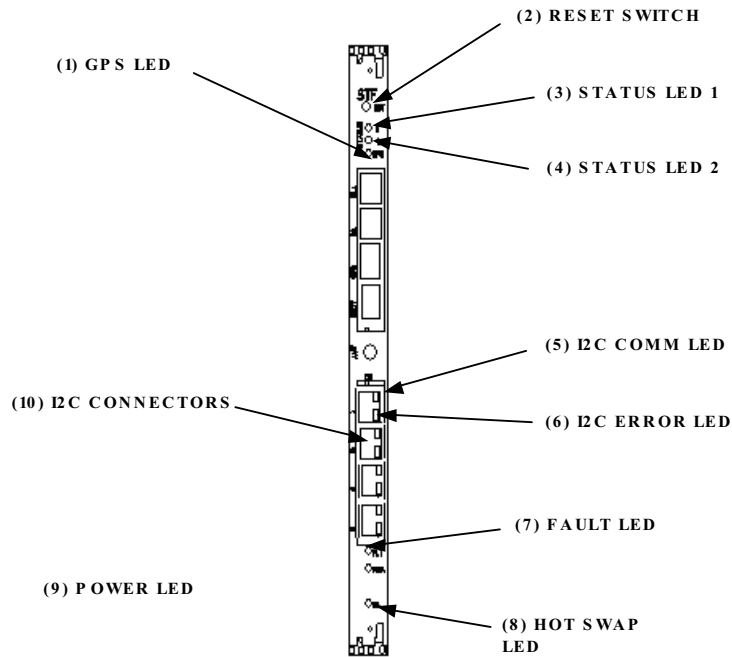


Figure 2-5. STF Front Panel

Table 2-5. STF User Interface

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	GPS LED	Single-colored LED (Green)	Indicator showing that 1PPS signal is available. Led toggles once per second (RAN only).
2	Reset Button	Recessed switch	Used to halt operation of the CPU operating system. A power ON reset is required to restart CPU.
3	Status LED 1	Single-colored LED (Yellow)	Reserved for future use. Status indicator turns yellow when CPU is not installed or has malfunctioned.
4	Status LED 2	Single-colored LED (Yellow)	Reserved for future use. Status indicator turns yellow when CPU is not installed or has malfunctioned.
5	I2C Comm LED's	Single-colored LED (Green)	On each I2C RJ-45 connector. Status indicator turns green when I2C message sent on port.
6	I2C Error LED's	Single-colored LED (Red)	On each I2C RJ-45 connector. Status indicator turns red when no response on port.
7	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed or upon startup until the module has completed initialization.

**Table 2-5. STF User Interface, continued**

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
8	Hot Swap LED	Single-colored LED (Blue)	Status indicator turns blue when board can be hot swap extracted. (not used)
9	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
10	I2C Connectors	RJ-45 connectors	I2C interface

## 2.3 SIF

The Sonet interface (SIF) is a Digital Chassis module that provides the RF to fiber interface between the Hub and RAN's. This interface includes RF signal information and 10BaseT Ethernet command and control information. This module is specified as one per RAN, plus one for each additional pair of tenants in each RAN (beyond the first pair).

At times the DIF output LED's can turn orange. This is because the RUC and accompanying RDC's are not yet tuned. The front panel indicators for the Sonet Interface are:

- **DIF Input 1-4 LED** – DIF Input Tri-color LED

- 1 - Off = Interface not enabled
- 2 - Green = good
- 3 - Yellow = degraded
- 4 - Red = no DIF™ signal lock or unused channel

Flashing = Interface is going in and out of lock, or high bip errors detected

- **DIF Output 1-4 LED** – DIF Output Tri-color LED

- 1 - Off = Interface not enabled
- 2 - Green = good
- 3 - Yellow = degraded
- 4 - Red = bad data on DIF™ output or unused channel

- **OPTICAL INPUT LED** – Optical Input Tri-color LED

- IN - Green = good
- IN - Yellow = degraded
- IN - Red = bad framing, bad parity, no signal, no lock

- **OPTICAL OUTPUT LED** – Optical Output Tri-color LED

- Green= good
- Yellow= degraded
- Red = bad output signal

- **FLT LED** – Red fault LED lighted when module has failed lite upon startup until the module has been initialized
- **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

If this LED is lighted without the green PWR LED lighted then the hot swap controller failed to initialize. Remove and reinstall module.

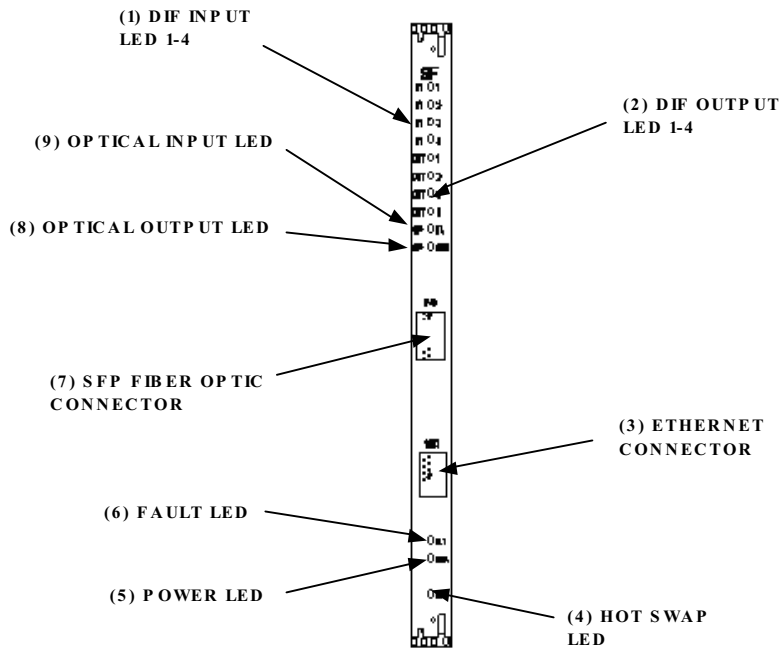


Figure 2-6. SIF Front Panel

Table 2-6. SIF User Interface

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	DIF Input 1-4 LED	Multi-colored LED (Green/Yellow/Red)	Indicator showing if the interface is not enabled (off), good (green), degraded (yellow) or no DIF tone lock or unused channel (red).
2	DIF Output 1-4 LED	Multi-colored LED (Green/Yellow/Red)	Indicator showing if the interface is not enabled (off), good (green), degraded (yellow) or bad data on output of unused channel (red).
3	Ethernet Connector	RJ-45 connector	
4	Hot Swap LED	Single-colored LED (Blue)	Status indicator turns blue when board can be hot swap extracted. (Not used in CXD)
5	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.

Table 2-6. SIF User Interface, continued

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
6	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized..
7	SFP Fiber Optic Connector	Dual-LC connectors	Fiber connector on SFP optical transceiver.
8	Optical Input LED	Multi-colored LED (Green/Yellow/Red)	Indicator showing if the SFP interface is not enabled (off), good (green), degraded (yellow) or bad framing, bad parity, no signal, or no signal lock (red).
9	Optical Output LED	Multi-colored LED (Green/Yellow/Red)	Indicator showing if the SFP interface is not enabled (off), good (green), degraded (yellow) or bad output signals (red).

### 3 RAN

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

#### 3.1 RDC

The RAN Down Converter (RDC) takes RF signals from a primary and secondary antenna and down converts the signals into IF. Signals are input into the card over coax cable terminated with SMA connectors on to the front panel of the module.

The front panel indicators for the RAN Down Converter are:

- **FLT LED** – Red LED lighted when module has failed or upon startup until the module has been initialized. This light will blink after the module receives a system clock and is awaiting initialization
- **PWR LED** – Green LED lighted when module has power

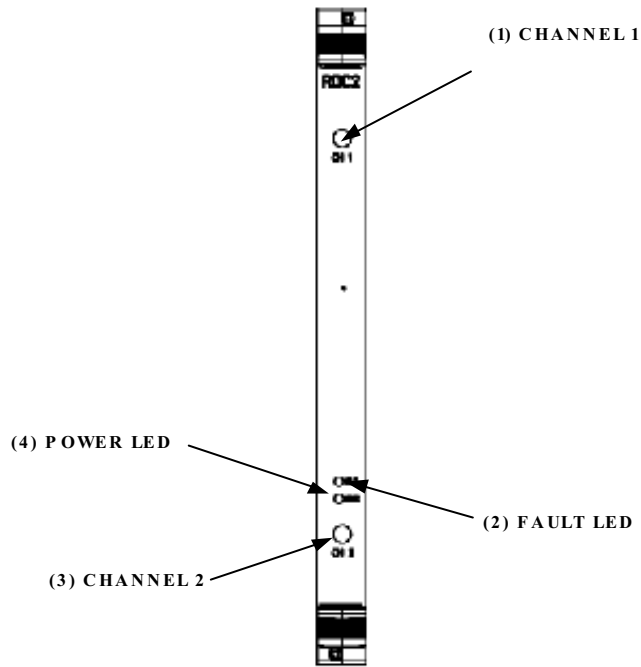


Figure 2-7. RDC2 Front Panel

Table 2-7. RDC2 User Interface

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Channel 1 RF Connector	SMA connector	RF input for Channel 1
2	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization
3	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
4	Channel 2 RF Connector	SMA connector	RF input for Channel 1



### 3.2 RUC

The RAN Up Converter (RUC3) takes IF signals from a DIF signal generated by a SIF and up converts the signals to RF. The RF is connected to

The front panel indicators for the RAN Up Converter are:

- **COM 1/3** – Yellow LED indicting DIF lock to SIF channel 3
- **COM 2/4** – Yellow LED indicting DIF lock to SIF channel 4
- **FLT LED** – Red LED lighted when module has failed or upon startup until the module has been initialized. This light will blink after the module receives a system clock and is awaiting initialization
- **PWR LED** – Green LED lighted when module has power

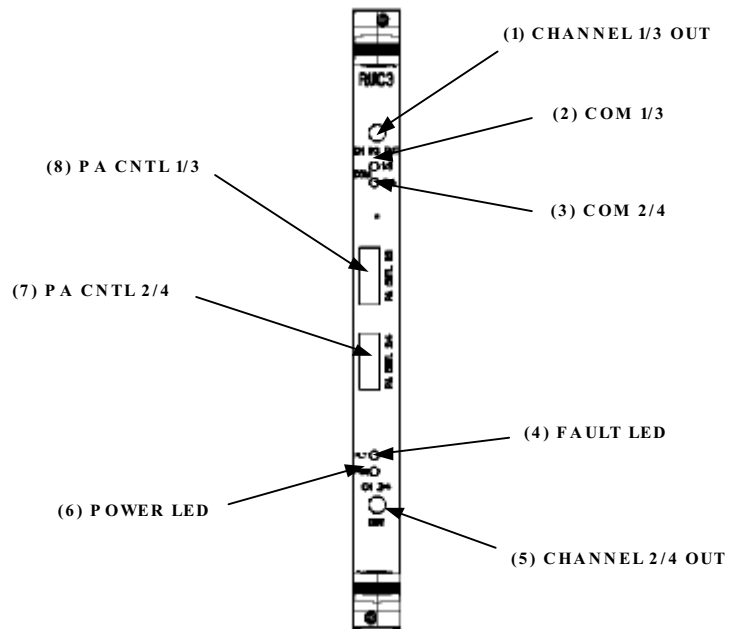


Figure 2-8. RUC Front Panel

Table 2-8. RUC3 User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Channel 1/3 Out Connector	SMA connector	RF output for Channel 3
2	COM 1/3	Single-colored LED (Yellow)	Status indicator turns yellow when DIF lock to SIF Channel 3
3	COM 2/4	Single-colored LED (Yellow)	Status indicator turns yellow when DIF lock to SIF Channel 4

**Table 2-8. RUC3 User Interface, continued**

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
4	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization
5	Channel 2/4 Out Connector	SMA connector	RF output for Channel 4
6	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
7	PA CNTL 2/4	I2C flatpack Connector	I2C Communications to RFA
8	PA CNTL 1/3	I2C flatpack Connector	I2C Communications to RFA

### 3.3 RF Assembly Module

The front panel indicators for the PA Interface Controller are:

- **DC\_IN** – Green LED lighted when module has –48VDC input
- **PA FAULT** – Red LED lighted when PA has failed
- **DC\_OUT** – Green LED lighted when module has 28 VDC output.

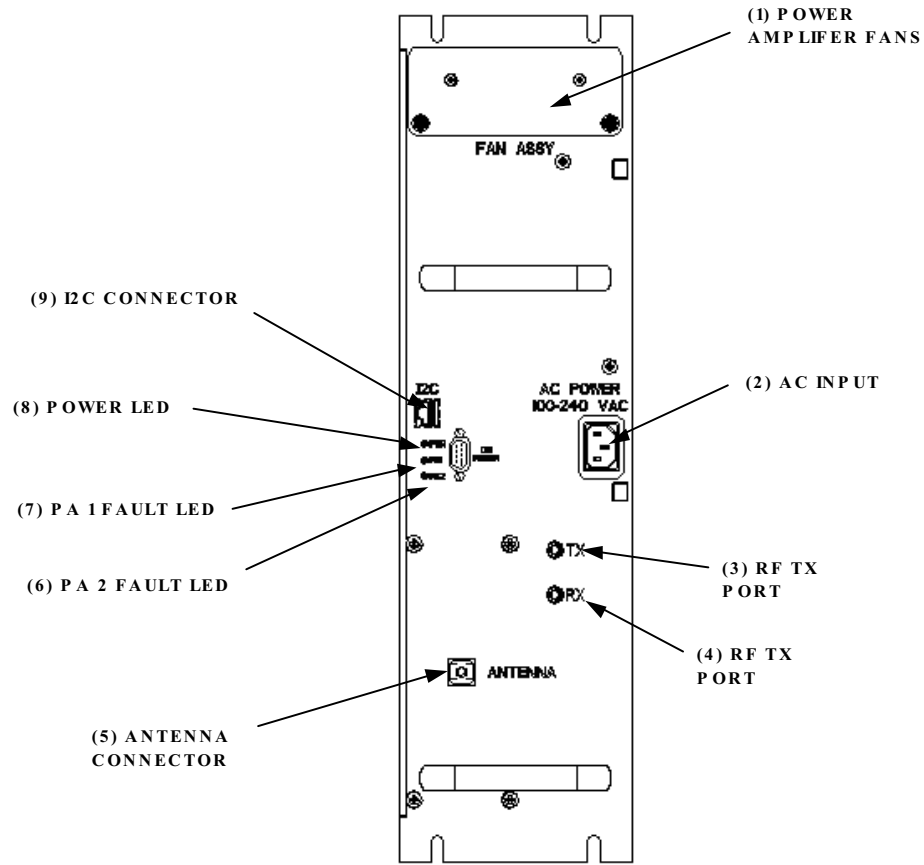


Figure 2-9. RF Assembly Module Front Panel

Table 2-9. RFA User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Power Amplifier Fans	Fan assembly	Access panel to RFA fans
2	A/C Input	3-prong A/C connector	A/C power interface
3	RF Tx Port	SMA connector	RF transmit input signal from HUC3
4	RF Rx Port	SMA connector	RF receive output signal from duplexer
5	Antenna connector	SMA connector	Duplexed transmit and receive RF signals interface into antenna
6	PA 1 Fault LED	Single-colored LED (Red)	Status indicator turns red when power amplifier 1 has failed
7	PA 2 Fault LED	Single-colored LED (Red)	Status indicator turns red when power amplifier 2 has failed
8	Power LED	Single-colored LED (Green)	Status indicator turns green when RFA has power.
9	I2C	RJ-45 connector	I2C communications interface

### 3.4 CompactPCI Power Supply

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

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

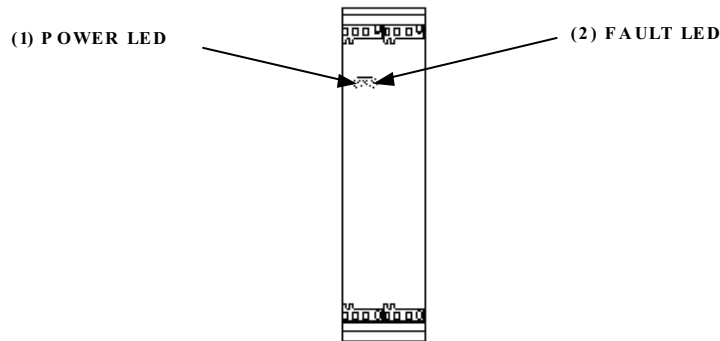


Figure 2-10. CompactPCI Power Supply Front Panel

Table 2-10. cPCI User Interface

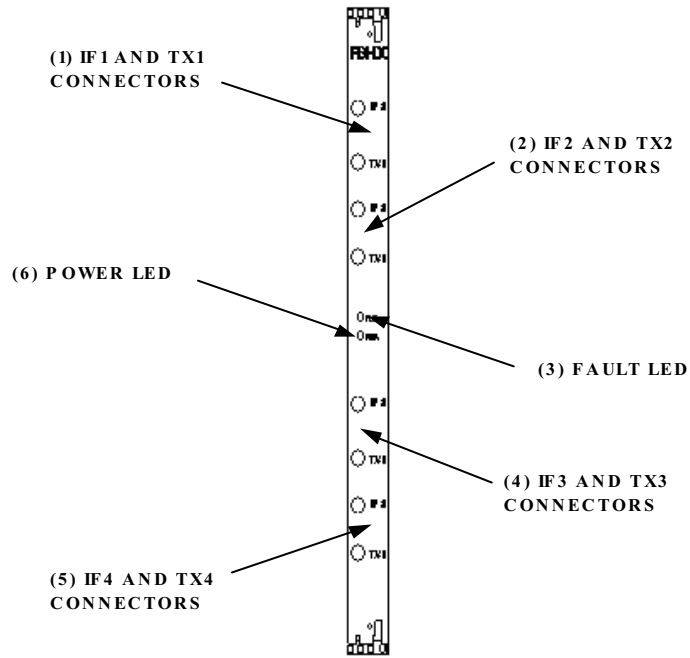
REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Fault LED	Single-colored LED (Yellow)	Status indicator turns yellow when power supply has failed
2	Power LED	Single-colored LED (Green)	Status indicator turns green when power supply has power.

## 4 HUB

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

### 4.1 Full Band HDC (FBHDC)

The Full Band Hub Down Converter supports a 15 MHz bandwidth for multi-carrier operation of wideband protocols (CDMA,1X) and narrowband protocols (GSM,TDMA, iDEN), with each RF input channel has its own input connection and RF/IF path.



**Figure 2-11. Full Band HDC Module**

**Table 2-11. Full Band HDC User Interface**

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	IF1 and TX1 Connectors	SMA connector	Transmit input and IF output for band 1
2	IF2 and TX2 Connectors	SMA connector	Transmit input and IF output for band 2
3	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed
4	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
5	IF3 and TX3 Connectors	SMA connector	Transmit input and IF output for band 3
6	IF4 and TX4 Connectors	SMA connector	Transmit input and IF output for band 4

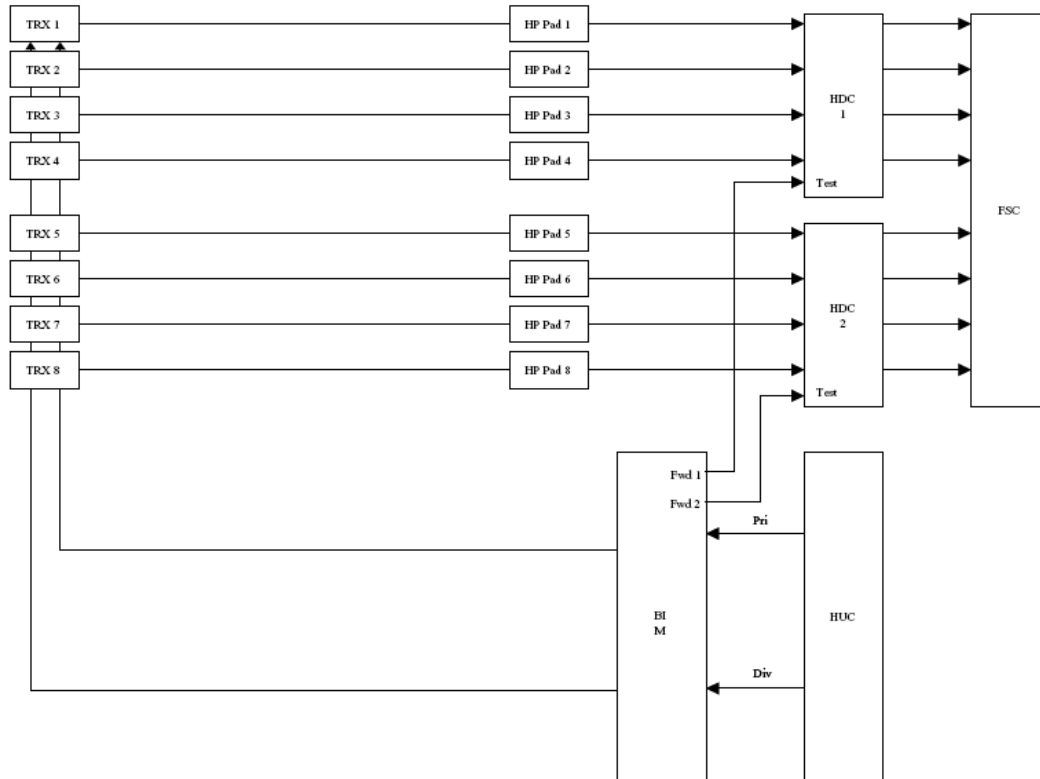
The FBHDC allows use of adjacent channels for GSM and IDEN and W-CDMA. It also offers unrestricted GSM frequency hopping. Channel tuning is not required, however band tuning is.

Four 20dB or 40dB attenuators are provided with each FBHDC. The attenuators allow a direct or coupled connection from the BTS while restricting the FBHDC input range. 20dB is used when coupled and 40dB is used when directly connected.

Additionally, the EEPROM will contain the offset from the +12 dB gain setting. This includes:

- Data for each channel (1-4)
- Offset for the start and end of each band

This data will be used when balancing a system. It is intended that software will automatically normalize the gains across channels to insure that the output data from the FSC has all channels equalized in gain to within 1 dB.



**Figure 2-12. Full Band HDC Interface**

## 4.2 Forward Simulcast Module, FSC

The Forward Simulcast module converts the IF signals from the HDC to Digitized IF (DIF) format. This module is specified at one per sector per tenant per 8 RAN's.

The front panel indicators for the Forward Simulcast Card are:

- **FLT LED** – Red LED lighted when module has failed or upon startup until the module has been initialized. This light will blink after the module receives a system clock and is awaiting initialization.
- **PWR LED** – Green LED lighted when module has power.

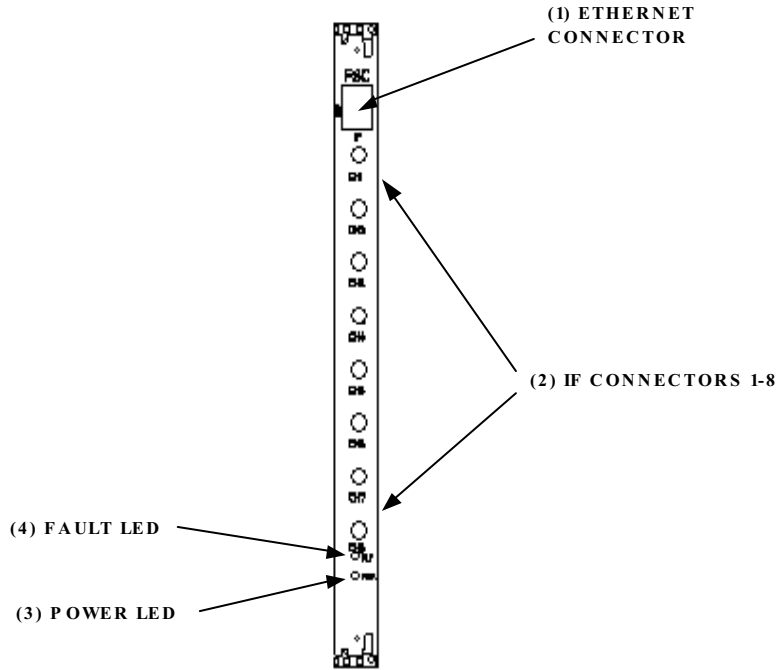


Figure 2-13. Forward Simulcast Card Front Panel

Table 2-12. FSC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Ethernet Connector	RJ-45 connector	Optional DIF signal input from alternate source
2	IF Connectors 1-8	SMA connectors	IF signal inputs from Full Band Hub Down Converter module (only port 1 used)
3	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
4	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization

### 4.3 Hub Upconverter Module, HUC

The front panel indicators for the Hub Up Converter are:

- **FLT LED** – Red LED lighted when module has failed or upon startup until the module has been initialized. This light will blink after the module receives a system clock and is awaiting initialization
- **PWR LED** – Green LED lighted when module has power
- **P/Lock LED** – Yellow LED lighted when Primary path is locked to RSC or SIF
- **D/Lock LED** – Yellow LED lighted when Diversity path is locked to RSC or SIF

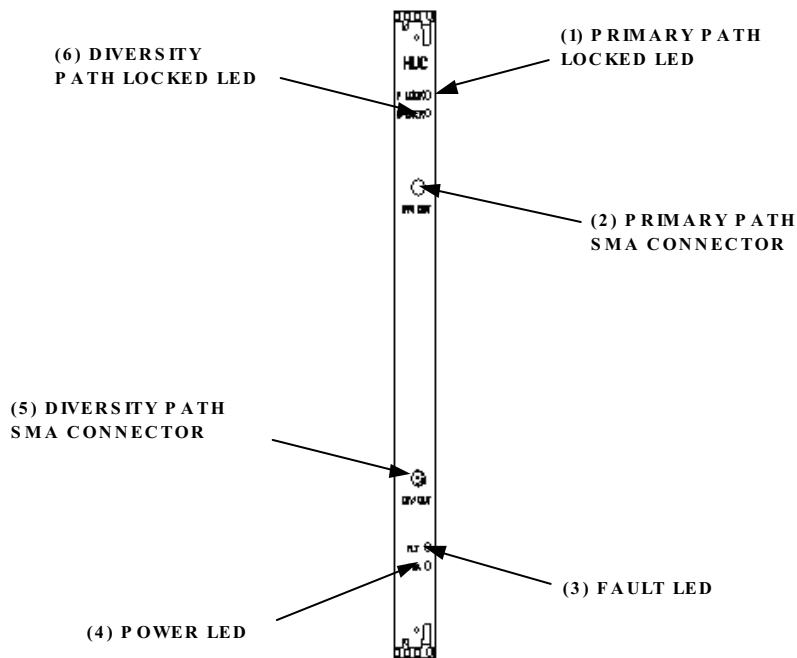


Figure 2-14. Hub Up Converter Front Panel

Table 2-13. HUC User Interface

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Primary Path Locked LED	Single-colored LED (Yellow)	Status indicator turns yellow when primary path is locked to RSC or SIF
2	Primary Path RF connector	SMA connector	RF connector for primary receive path
3	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization



**Table 2-13. HUC User Interface, continued**

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
4	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
5	Diversity Path RF connector	SMA connector	RF connector for diversity receive path
6	Diversity Path Locked LED	Single-colored LED (Yellow)	Status indicator turns yellow when diversity receive path is locked to RSC or SIF

#### 4.4 Reverse Simulcast Module, RSC

The RSC sums the Digital IF (DIF) from up to Four (4) (8) RAN's utilizing diversity requires a pair of DIF signals that are sent to the HUC for up conversion to RF. The RSC is utilized in the Digital Chassis and is specified as one per tenant per sector per 4 RAN's, plus an additional one RSC for RAN's 5-7, and an additional one RSC for RAN 8.

The front panel indicators for the Reverse Simulcast are:

- **DIF INPUT 1-8 LED's** – DIF™ Input Tri-color LED's
- **Labeled IN 1 – 8**
  - Off = No input signal
  - Green = Good
  - Yellow = Degraded
  - Red = Bad
- **DIF OUTPUT 1-4 LED's** – DIF™ Output Tri-color LED's
- **Labeled OUT 1 – 4**
  - Off = No input signal
  - Green = Good
  - Yellow = Degraded
  - Red = Bad
- **FLT LED** – Red LED lighted when module has failed
- **PWR LED** – Green LED lighted when module has power
- **HS LED** – Hot Swap LED, turns blue when board can be hot swap extracted

Each RSC module supports primary and diversity reverse DIF path summation and outputs two (2) separate DIF signals.

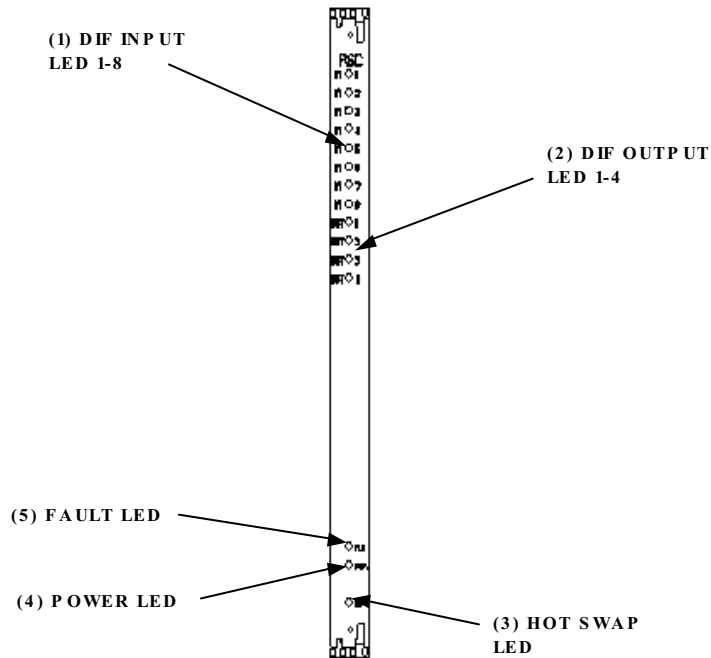


Figure 2-15. Reverse Simulcast Card Front Panel

Table 2-14. RSC User Interface

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	DIF Input LED 1-8	Multi-colored LED (Green/Yellow/Red)	Indicator showing if no input signal (off), good (green), degraded (yellow) or bad data on channel (red).
2	DIF Output LED 1-4	Multi-colored LED (Green/Yellow/Red)	Indicator showing if no input signal (off), good (green), degraded (yellow) or bad data on channel (red).
3	Hot Swap LED	Single-colored LED (Blue)	Status indicator turns blue when board can be hot swap extracted. (Not used in CXD)
4	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
5	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed.

### 4.5 Hub Reference Module, HRM

The Hub Reference Module (HRM) provides GPS timing and clocking data that gets distributed throughout a Digivance CXD Hub.

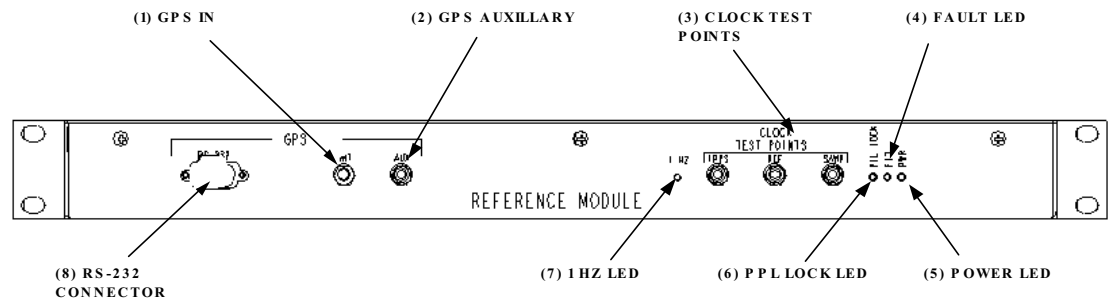


Figure 2-16. Hub Reference Module Front Panel

Table 2-15. HRM Front Panel User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	GPS Input Connector	SMA connector	Input of GPS antenna signal
2	GPS Auxiliary	SMA connector	Auxiliary GPS input
3	Clock Test Points	SMA connectors	
4	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed.
5	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
6	PLL Lock	Single-colored LED (Yellow)	Status indicator when phase lock loop circuit is locked
7	1 Hz LED	Single-colored LED (Yellow)	Status indicator when 1 Hz signal detected
8	GPS RS-232	DB9 connector	Output of GPS signal to STF2 module

- **GPS**

RS-232 DB 9 connector brings GPS to the STF2 module

GPS SMA is the input from the Hub GPS antenna

AUX SMA brings the GPS to the HRM in the next Hub rack

- **1 HZ LED**

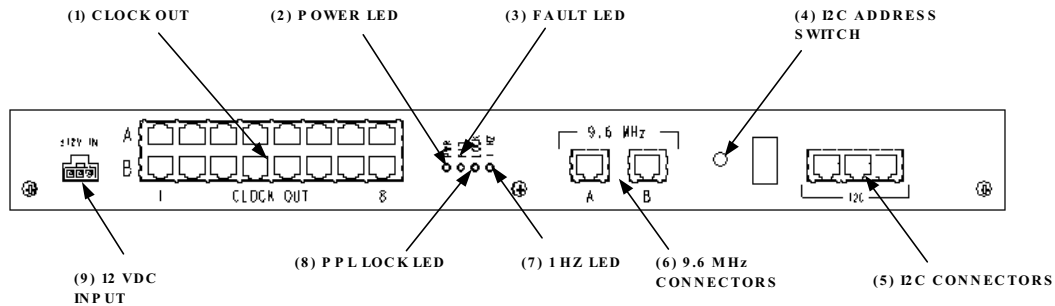
- **Clock Test Points**

- 1 PPS – One Pulse Per Second from GPS
- REF – 9.6 MHz RF Reference Clock
- Samp – 42.912 MHz Sample Clock

- **LED's**

- PLL lock – Yellow – indicates the phase lock loop circuit is locked
- FLT – Red – indicates there is a fault with the HRM
- PWR – GRN – indicates power is applied to the HRM

Refer to the Digivance CXD Installation Manual for details on I2C configuration.



**Figure 2-17. Hub Reference Module Rear Panel**

**Table 2-16. HRM Rear Panel User Interface**

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	GPS Clock Out	RJ-45	GPS signal output connectors
2	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
3	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed.
4	I2C Address Switch	Recessed switch	
5	I2C Connectors	RJ-45 connectors	I2C interface
6	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
7	PPL Lock	Single-colored LED (Yellow)	Status indicator when phase lock loop circuit is locked
8	1 Hz LED	Single-colored LED (Yellow)	Status indicator when 1 Hz signal detected
9	GPS RS-232	DB9 connector	Output of GPS signal to STF2 module

## 4.6 Ethernet Switch

The front panel indicators for the Ethernet switch are:

- **Power LED** – Lighted 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 LED's** – Lit when port is transmitting or receiving data
- **100 LED's** – Lit when operating at 100 Mbps

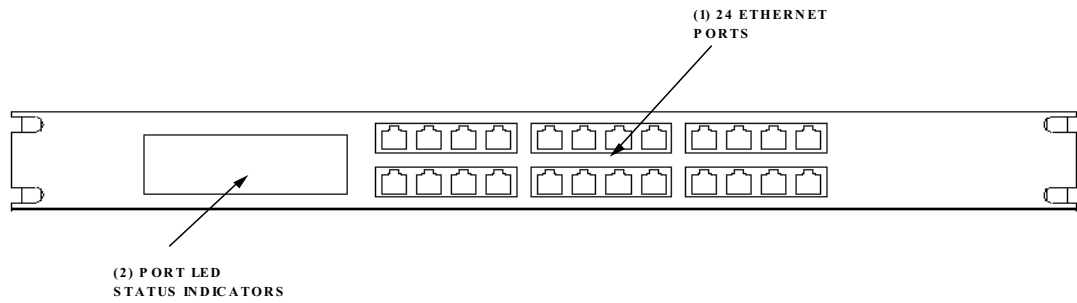


Figure 2-18. Ethernet Switch Front Panel

Table 2-17. Ethernet Hub Front Panel User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Ethernet Connectors	RJ-45	Ethernet ports
2	Activity LEDs	Single-colored LED Array	Status indicators show Ethernet traffic on hub ports.

## 4.7 BTS Interface Module, BIM

The I2C address must be selected prior to power on. Refer to the Digivance CXD Hardware configuration manual for details on I2C configuration. BIM I2C should be '5'.

The front panel indicators for the BTS Interface 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
- **I2C Address display** – Displays I2C address, 0-5
- **SMR/CELL/PCS** – Indicates Protocol
- **PWR** - Indicates Power is applied
- **FAULT** – Indicates BIM Fault

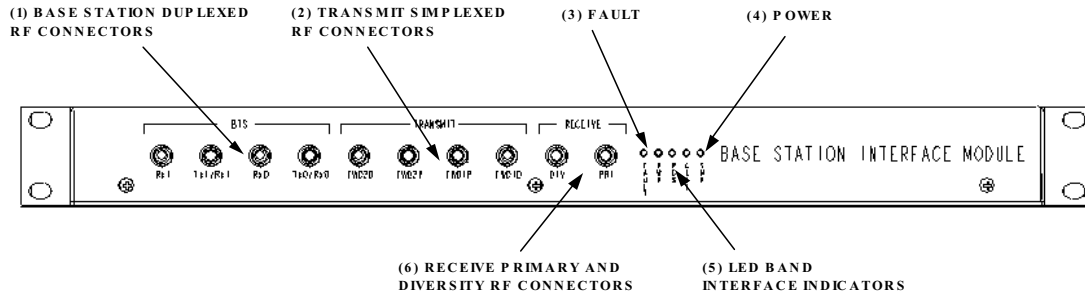


Figure 2-19. BTS Interface Module Front Panel

Table 2-18. BIM Front Panel User Interface

REFN o.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Base Station Duplexed RF Connectors	SMA	RF forward and reverse path inputs
2	Transmit Simplex RF Connectors	SMA	RF forward path outputs to Hub
3	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed.
4	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
5	LED Band Indicators	Single-colored LED (Yellow)	Status indicator turns yellow showing which band is active with unit
6	Receive Simplex RF Connectors	SMA	RF reverse path inputs from Hub

## 4.8 Attenuator Shelf

The original BIM had the attenuators mounted internally to the BIM. The later version of the BIM moved the attenuators outside the BIM and mounted to an attenuator shelf. The attenuator shelf is mounted at the top of the Hub rack. It can hold up to twelve (12) 50 watt attenuators.

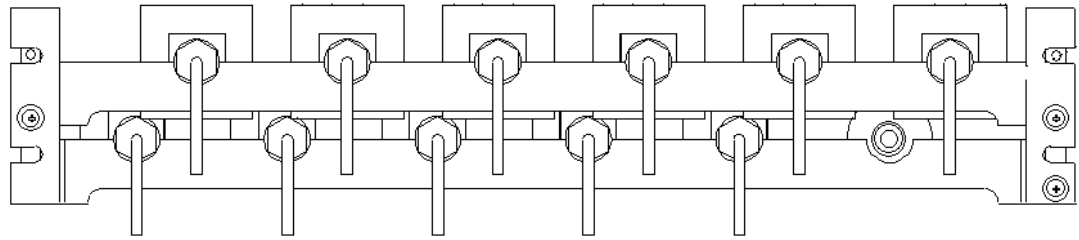


Figure 2-20. Attenuator Shelf

## 4.9 Specifications

The specifications for the Digivance CXD are provided in Table 2-19. All specifications apply after a five minute warm-up period.

Table 2-19. Digivance CXD Specifications

PARAMETER	SPECIFICATION	REMARKS
<b>Optical – Hub and RAN</b>		
Fiber type	9/125, single-mode	
Number of fibers required		
Without WDM	2	
With WDM With CWDM	1 1 per 4 RANS	Requires CWDM optical transceivers and wavelength division multiplexers (WDM) which are accessory items.
Optical transceiver type	SFP	
Forward and reverse path wavelength Standard range Extended range	1310nm 1550 nm	
Optical transmit power output Standard range Extended range	0 dBm 0 dBm	Typical
Optical receive input Standard range Extended range	-13 dBm -25 dBm	
Optical budget Standard range Extended range	10 dB 22 dB	Typical
Optical connectors	LC	Dual-connector
Insertion loss	< 12 dB	
<b>RF Forward Path</b>		
800 MHz Fullband	869 to 894 MHz	15 MHz bandwidth selectable
800 MHz A''/A		15 MHz bandwidth selectable
SMR 800 MHz	851 to 869 MHz	15 MHz bandwidth selectable

**Table 2-19. Digivance CXD Specifications, continued**

PARAMETER	SPECIFICATION	REMARKS
SMR 900 MHz	935 to 940 MHz	
1900 MHz Lowerband	1930 to 1965 MHz	15 MHz bandwidth selectable
1900 MHz Upperband	1965 to 1995 MHz	15 MHz bandwidth selectable
Intermodulation	-60 dBc	At remote output, two tone
Spurious	-60 dBc	
RF gain	10 dB	
Gain flatness Band flatness Channel flatness	±2.0 dB across freq. Range ±1 dB variation across any 1.25 MHz channel	
Gain Variation	± 3 dB	Over frequency, temperature, and unit-to-unit.
Peak to Average Ratio	10 dB	
Propagation Delay	12 microseconds forward path	Excludes fiber
Configurable propagation delay Range Delay step size	0 – 566 microseconds 13 nanosecond increments	Manual or automatic
Composite RF input signal level	-25 to +10 dBm	Per RF band, non-duplexed
Composite RF output power Cellular/SMR 10 MCCA PCS 10 Watt MCCA PCS 20 Watt MCCA	6.5 Watts (+38 dBm) 6.5 Watts (+38 dBm) 12.5 Watts (+41 dBm)	Composite at antenna port. See Note 1 at end of table.
Performance merit functions TDMA/EDGE GSM iDEN CDMA	5% EVM 3.5° RMS SQE decrease < 1 dB 0.98 Rho factor	
<b>RF Reverse Path</b>		
800 MHz Fullband	824 to 849 MHz	15 MHz bandwidth selectable
800 MHz A''/A		15 MHz bandwidth selectable
SMR 800 MHz	806 to 824 MHz	15 MHz bandwidth selectable
SMR 900 MHz	896 to 901 MHz	
1900 MHz Lowerband	1850 to 1885 MHz	15 MHz bandwidth selectable
1900 MHz Upperband	1885 to 1915 MHz	15 MHz bandwidth selectable
Gain	-10 to +35 dB	
Gain flatness Band flatness Channel flatness	±2.0 dB across freq. Range ±1 dB variation across any 1.25 MHz channel	
Gain variation	± 3 dB	Over frequency, temperature, and unit-to-unit.
Propagation Delay	12 microseconds forward path	Excludes fiber



**Table 2-19. Digivance CXD Specifications, continued**

PARAMETER	SPECIFICATION	REMARKS
Configurable propagation delay Range Delay step size	0 – 566 microseconds 13 nanosecond increments	Manual or automatic
Input IP3	-21 dBm	
Noise figure 800/850/900 MHz 1900 MHz	5 dB 6 dB	
Minimum RF output level	10 dBm -5 dBm	Absolute maximum Operational maximum
Automatic Gain Limiting (AGC) Range Maximum input signals	25 dB -38 dBm	Peak signal input
Reverse path VSWR	2.0:1	
<b>Physical/Environmental/Electrical – Hub</b>		
Dimensions (HxWxD)	78 x 24 x 24 Inches	Hub rack
Color	Putty white	
RF connections	50 ohm SMA-type (female)	50 ohm input/output impedance
Weather resistance	Indoor installation only	
Operating temperature	0° to 50° C (32° to 122° F)	
Storage temperature	-40° to +70° C (-40 to 158° F)	
Humidity	10% to 90%	Non condensing
IP interface	RJ-45	
DC power connector	Screw-type terminal	
Power Input	±48 VDC	Floating
Input current	34 A @ -42 VDC	Per rack assembly
Reliability	MTBF 80,000	Excluding fan assemblies
<b>Physical/Environmental/Electrical – RAN</b>		
Dimensions (HxWxD)	23 x 18 x 11 Inches	2.6 cubic feet
Color	Gray	
RF connections	50 ohm N-type (female)	50 ohm input/output impedance
Weather resistance	NEMA-3R	Removable dust filter
Operating temperature	-40° to 50° C (-40° to 122° F)	
Storage temperature	-40° to +85° C (-40 to 185° F)	
Humidity	10% to 90%	
IP interface	RJ-45	
AC power ingress	¾-inch conduit	Internal diameter
Fiber optical cable ingress	¾-inch conduit	Internal diameter
Power input	90 to 260 VAC	47 to 63 Hz
Lightning protection	20 kA IEC 1000-4-5 8/20 microsecond waveform	

**Table 2-19. Digivance CXD Specifications, continued**

<b>PARAMETER</b>	<b>SPECIFICATION</b>	<b>REMARKS</b>
Battery backup options Internal – Slot assembly External	1 hour 2 hour	Takes one RFA slot
Power consumption	600 W	Two 10 W PA option
Reliability at 25°	MTBF 50,000	Excluding fan assemblies

Note 1: Per Industry Canada Section 5.3 - The rated output power of this equipment is for single carrier operation. For situations where multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. The power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device.

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## 1 INTRODUCTION

This section discusses the steps necessary to setup the Digivance CXD-Hub system communications and operating parameters. It is assumed for the purposes of this discussion that the required system elements have already been installed and powered on, and that the reader has an understanding of TCP/IP networking basics.

## 2 NETWORKING OVERVIEW

A Digivance CXD network consists of several CPUs running the Linux operating system as shown in Figure 3-1 Network Architecture. The CPUs residing in the Digivance CXD-Hub Hub (called "Hub nodes") are connected through a router to an existing LAN to effect SNMP status and control. The CPUs in the RAN's (called "RAN nodes") are connected to the LAN using WAN bridges in each SIF, which transmit packet data across a fiber back-haul from each RAN node to its corresponding HUB. Each Digivance CXD-Hub node supports telnet, ftp, and vnc by default. See Section 9.4 "Accessing Nodes via TCP/IP for details.

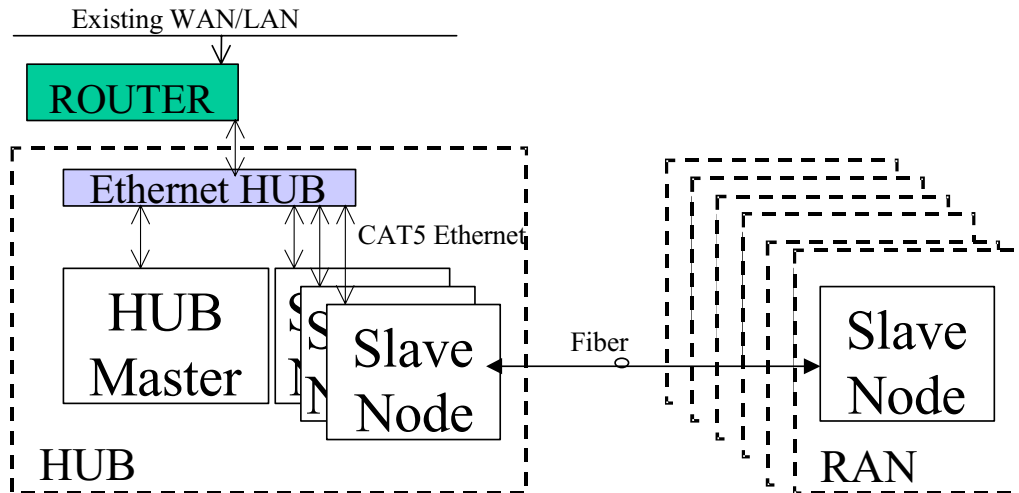


Figure 3-1. Network Architecture

A CPU called the Hub Master is a special Hub node that controls tenant processing for Digivance CXD nodes on its subnet. For a definition of tenant sectors, see Section 6.1. The Hub Master also functions as a time server for a Digivance CXD subnet (using Network Timing Protocol), and can be set up to provide DHCP (Dynamic Host Configuration Protocol) and DNS (Domain Name Service) to its subnet as well. It is important for Digivance CXD system software that only one Hub Master node resides on each subnet, and that each subnet has a unique domain name. The Hub Master node is the only node that requires a static IP. The Digivance CXD network architecture utilizes DHCP and DNS to identify the rest of the nodes, either through pre-existing LAN servers, or through the Digivance CXD Hub Master CPU. For more on configuring these features and the Hub Master itself, see Section 10, "Configuring the HUBMASTER node."

### **3 NODE IDENTIFICATION SCHEMES**

It is important to follow a convention when naming nodes in the Digivance CXD system so that CPUs can be quickly located and accessed for troubleshooting and maintenance. The suggested naming conventions for both Hub and RAN nodes are discussed in the following sections. For more information concerning node identity configuration, see Sections 11.1 and 11.2.

### **4 IDENTIFICATION USING THE NETWORK IP RECEIVER/SENDER SYSTEM**

The Digivance CXD Hub Master node dynamically keeps track of which nodes are under its control using a script called NIPR (Network IP Receiver). It receives an IP and hostname from every node it controls via NIPS (Network IP Sender), which runs on all "slave" nodes. NIPR senses any changes to its list of slave nodes, and updates the Hub Master DNS accordingly. The NIPR/S system is also a key component to maintaining the Hub/RAN Node MIB's and tenant processing, since it is the mechanism by which the Hub/RAN Node MIB entries are filled. For more on these MIB's, see Sections 11.1 and 11.2.

### **5 HUB EQUIPMENT IDENTIFICATIONS**

Table 3-1 shows the recommended convention to be used for identifying and placing Hub equipment:

**Table 3-1. HUB Rack Numbering**

CHASSIS OR SHELF HEIGHT	LOCATION*
Attenuator Shelf 2U	U42
PDU 2U	U40
Ethernet Hub 1U	U38
Digital Chassis (top) 4U	U37
BIM 1U	U33
RF Chassis (top) 4U	U32
BIM 1U	U28
Digital Chassis (top) 4U	U27
BIM 1U	U23
RF Chassis (top) 4U	U22
BIM 1U	U18
Digital Chassis (top) 4U	U17
BIM 1U	U13
RF Chassis (top) 4U	U12
BIM 1U	U8
Reference Module (bottom) 1U	U7

\*Measurements are from the bottom of the OP-HUB2 rack.

- Hub Racks are numbered sequentially, Rack1, Rack2, etc, or by serial number.
- Chassis in Hub racks are numbered by U number. For example, the lowest RF chassis shown in Table 3-1 Would be numbered U12.
- BIM's in racks are numbered by U number. For example, the lowest BIM shown in Table 3-1 Would be numbered U8.
- Power Attenuators are located at the top of the Hub rack or mounted to a wall.
- WSP Base stations should be given unique Tenant Name and BTS ID designations.
- Each base station sector is cabled to a separate attenuator and BIM unit in the Hub rack.
- Ensure that RF cables from the BIM forward output ports are connected to HDC modules in its related HUB RF chassis.
- Ensure that RF cables from the BIM reverse input ports are connected to HUC modules (primary to primary and diversity to diversity). Further ensure that any HUC and HDC modules connected to a given BIM reside in the same Hub RF chassis.

- Ensure that HDC modules are connected to FSC modules as shown in the diagram. HDC's below an FSC have their outputs connected to FSC inputs 1, 3, 5, and 7. HDCs above an FSC have their outputs connected to FSC inputs 2, 4, 6, and 8. HDCs using composite mode will only require HDC Output IF 1 to be connected to FSC CH 1.
- An RF chassis in a Hub rack contains enough slots for 2 sets of tenant RF equipment, where a set of tenant RF equipment consists of one FSC, one HUC and up to two HDC's. A set of tenant equipment in an RF chassis is installed in a particular manner, from bottom to top, the order of modules is HUC, HDC, FSC, and HDC. The locations of modules in the chassis must also follow a particular pattern, such that the first set of tenant modules must occupy the four bottom-most slots in the chassis, the second set must occupy the next four slots. Refer to Table 3-2. RF Chassis Configuration for more details.

Table 3-2 illustrates the chassis configuration:

**Table 3-2. RF Chassis Configuration**

CHASSIS SLOT	MODULE	TENANT
1	HUC	1
2	HDC	1
3	FSC	1
4	HDC	1
5	HUC	2
6	HDC	2
7	FSC	2
8	HDC	2

## 6 ASSIGNING TENANTS

### 6.1 Understanding Tenant MIB Indexing

Throughout the Digivance CXD system, there are several MIB's that are used to monitor and control tenant activity. These tenant-based MIB's contain tables with 96 separate entries/columns, where each entry/column in a table belongs to a given tenant base station sector. The index value used for each base station sector is constant across the entire system such that once a tenant sector is configured and an index is established, the same index will be associated with that tenant sector in all system-wide tenant-based MIB's.

(\*) The Digivance CXD system can support up to 96 unique base station sectors per Hub Master CPU.

## 6.2 BTS Connection MIB

Within the Hub Master node, the BTS Connection MIB is used to create new tenant base station sector instances (simply called "tenants" from here on) to be configured, monitored, and controlled in the Digivance CXD system. In order to create a new tenant in the Digivance CXD system, the Hub Config Process in the Hub Master must first locate a unique BIM instance controlled by one of the Hub CPUs. This requires that the Hub Node first be configured such that the CPU Rack ID and Chassis ID are known (described in Section 11.1 of this document). The software in the Hub Master continues to send requests to all configured Hub Nodes to determine if there are any BIM modules that have come online.

When a never-been-seen-before BIM module is located, the Hub Config Process creates an "Unconfigured" tenant in the BTS Connection MIB. This can be seen by noticing that the Tenant ID in the BTS Connection MIB is "UnconfiguredX", where X is 1-96. Also, it can be seen that the CPU Rack and Chassis IDs are filled in and the BIM I2C Bus/Slot information is filled in. At this point, the rest of this tenant must be configured manually.

### 6.2.1 Setting the Tenant Name

Tenant Name is the name of the Wireless Service Provider (WSP). The allowable value is a string length of 1-17 characters. The MIB field is:

*transceptBtsConnectionTable.transceptBtsConnectionTenantName.*

### 6.2.2 Setting the BTS ID

Since WSP's may have more than one base station (BTS) in the system, it is important to uniquely identify them - the allowable value is a string of 1-8 characters. The MIB field is:

*transceptBtsConnectionTable.transceptBtsConnectionBTSID.*

### 6.2.3 Setting the BTS Sector

The BTS Sector field of the BTS Connection MIB is an enumerated value, where the allowable selections are ALPHA (0), BETA (1), or GAMMA (2). The MIB field is:

*transceptBtsConnectionTable.transceptBtsConnectionBTSSector.*

### 6.2.4 Setting the Tenant Band

The Tenant Band field of the BTS Connection MIB is an enumerated value, where the allowable selections are the bands supported by the Digivance CXD system, currently:

- No Band (0) - no band selected, will not result in a configured tenant
- US1900A (1) - PCS band A
- US1900B (2) - PCS band B
- US1900C (3) - PCS band C
- US1900D (4) - PCS band D



US1900E (5) - PCS band E  
 US1900F (6) - PCS band F  
 US800AAPP (7) - Cellular A and A' bands  
 US800BBP (8) - Cellular B and B' bands  
 US800AP (9) - Cellular A' band  
 US800SMR (10) - Cellular SMR band

The MIB field is:

*transceptBtsConnectionTable.transceptBtsConnectionTenantBand*

### 6.2.5 Setting the BIM Rack/Shelf ID

The location information (rack/shelf) of the BIM module belonging to this tenant must be configured. The valid values for these MIB fields are strings of 1-16 characters (see Hub Equipment Identification section above for more information about the values that should be used). The Hub Config Process will push these ID strings down to the Network Node MIB of the CPU that controls this BIM. This will allow the NMS to identify the location of the BIM when it is reporting a fault condition. The MIB fields are:

*transceptBtsConnectionTable.transceptBtsConnectionBimRackID*

and

*transceptBtsConnectionTable.transceptBtsConnectionBimShelfID*

### 6.2.6 Designating the Tenant Hardware

The BTS Connection MIB contains several fields pertaining to the location of the tenant-specific hardware. Though every effort was made to minimize the configuration necessary, some of the connections made between hardware are not automatically detectable, and therefore require some manual intervention.

Using the information in the Hub Cabling section above, the I2C addresses of the RF modules belonging to the tenant being configured must be set as follows:

- The BIM I2C Address (bus/slot) will automatically be filled in by the Hub Config Process. The MIB fields are:

*transceptBtsConnectionTable.transceptBtsConnectionBimI2cBus*

and

*transceptBtsConnectionTable.transceptBtsConnectionBimI2cSlot*

- The BIM module belonging to this tenant must have RF connections to either one or two HDC modules. Based on the table in the Hub Cabling section above, select the I2C Bus and Slot of the HDC module(s) based on the position of the module(s) in the RF chassis. As indicated in the Hub Cabling section above, the two HDC's belonging to a single tenant (i.e. having RF connections to the same BIM module) should be co-located in the RF chassis, with only an FSC module separating them. The MIB fields are:

*transceptBtsConnectionTable.transceptBtsConnectionHdcXI2cBus*

and

*transceptBtsConnectionTable.transceptBtsConnectionHdcXI2cSlot*, where *X = 1 or 2*.

- The HDC modules belonging to this tenant are cabled to a single FSC module, which is located in a chassis slot either directly above and/or below the tenant's HDC module(s). Based on the table in the Hub Cabling section above, select the I2C Bus and Slot of the FSC module belonging to the tenant being configured. The MIB fields are:

*transceptBtsConnectionTable.transceptBtsConnectionFscI2cBus*

and

*transceptBtsConnectionTable.transceptBtsConnectionFscI2cSlot*.

- When using receive diversity, the BIM module belonging to this tenant must have two RF connections to a single HUC module. One for primary reverse signals and the other for diversity reverse signals. Without receive diversity, only the Primary HUC output need be cabled to the BIM. The location of the HUC module for this tenant must be co-located with the HDC and FSC modules belonging to this tenant, as described in the Hub Cabling section above. Based on the table above, select the I2C Bus and Slot of the HUC module belonging to the tenant being configured. The MIB fields are:

*transceptBtsConnectionTable.transceptBtsConnectionHucI2cBus*

and

*transceptBtsConnectionTable.transceptBtsConnectionHucI2cSlot*.

Once the above I2C Addresses are set for the tenant being configured, the Hub Config Process will push this information down to the Hub RF Connection MIB on the node/CPU that manages the tenant RF hardware.

### **6.2.7 Clearing tenants**

It is possible to "de-configure" a tenant, which will clear all of the configuration information described above, by setting the Clear field in the BTS Connection MIB for this tenant to a value of '1'. This will allow the configuration process to be restarted from the beginning. The MIB field is:

*transceptBtsConnectionTable.transceptBtsConnectionClear*

### **6.2.8 HUC Invalid Config**

The BTS Connection MIB contains a read-only field that reports the state of the HUC (belonging to this tenant) Invalid Configuration fault field. This information will allow the person configuring the system to know that the tenant has been completely and correctly configured - this is known when the value in this field is reported as "No Fault" or '0'. The MIB field is:

*transceptBtsConnectionTable.transceptBtsConnectionHucInvalidConnection*.

### 6.2.9 Maximum Number Of Carriers

This parameter is no longer used in the Digivance CXD system.

*transceptBtsControlParamsTable.transceptBtsControlParamsMaxCarriers.*

### 6.2.10 Composite Mode

The Digivance CXD default forward gain balance is called “composite mode”. In this mode, an RF input signal of -4 dBm RMS at HDC input “RF 1” will yield an output of 38 dBm RMS at each RAN antenna port. As the protocol is irrelevant in this mode, the default protocol is “none”. In addition, only a single FSC channel is activated. To sum multiple FSC channels, set the composite mode entry to “disabled” and follow instructions on setting channels in the Tenant Configuration section of this document.

*transceptBtsConnectionForwardGainTable.transceptBtsConnectionForwardGainCompositeModeFlag*

### 6.2.11 Power Attenuator IDs

The BTS Connection MIB contains two fields that allow the external power attenuators to be identified. The attenuators reside in a shelf at the top of each rack. To configure these two MIB fields, the nomenclature described in Table 3-1. HUB Rack Numbering, should be used. This dictates that the attenuators should be given names that indicate the shelf number and the location on the shelf. For a given tenant, the two power attenuators must be configured with unique IDs, where the allowable values are strings of length 1-16. If both attenuators are configured, then software will configure the BIM to operate in duplexed mode, otherwise, software will configure the BIM to operate in non-duplex mode. The MIB fields are:

*transceptBtsControlParamsTable.transceptBtsControlParamsPowerAttenXLoc*, where X = 1 or 2.

## 6.3 Pathtrace Format

Pathtrace is a term used to describe the 64-byte data stream that is transmitted between all DIF-connected modules in the Digivance CXD system. The contents of the pathtrace strings have been designed such that each set of connected tenant equipment will transmit/receive a pathtrace string containing information about that particular tenant. The following is the format of the pathtrace string:

<Tenant ID><delimiter><IP Address><delimiter><Path Flag>

- The Tenant ID sub-string is comprised of four particular pieces of information: Tenant Name, BTS ID, BTS Sector, and Tenant Band. These four pieces of information form the Tenant ID sub-string, where each piece of information is delimited by a single character (currently a colon ":").
- The IP Address sub-string indicates the IP Address of the CPU node that transmits the pathtrace string.

- The Path Flag is a one-character string, “M”, "P" or "D" that indicates the path through which the path trace was transmitted (“M”=Main Forward, “P”=Primary Reverse, “D”=Diversity Reverse). The delimiter used to separate the primary sub-strings of the pathtrace string is a single character, currently a comma (",").

An example of a complete pathtrace string is as follows:

*wspname:bts4:alpha:us1900A,172.20.1.1,P*

### 6.3.1 Pathtrace Creation

In the Assigning Tenants and BTS Connection MIB sections above, the components of the Tenant ID portion of the pathtrace string were described. When these four pieces of information are configured, they are combined into the Tenant ID string by a process known as the Tenant Scanner, which spawns a new tenant process to manage the tenant identified by this Tenant ID. Upon creation, the Tenant ID string is pushed down to the Hub RF Connection MIB in the node/CPU that is controlling a tenant's RF equipment.

The hardware control processes (HCP's) corresponding to the BIM, HDC(s), and FSC that belong to a given tenant each create the pathtrace string that will be transmitted throughout the system for this tenant. They start with the Tenant ID of the Hub RF Connection MIB and append a delimiting character and the IP address of the CPU that those HCP's are running on. All three HCP's report this pathtrace string in their MIB's for use by tenant processing and other higher-level processes, as described in Chapter 6. For a graphical depiction of how pathtrace flows through the Digivance CXD System, see Figure 3-2.

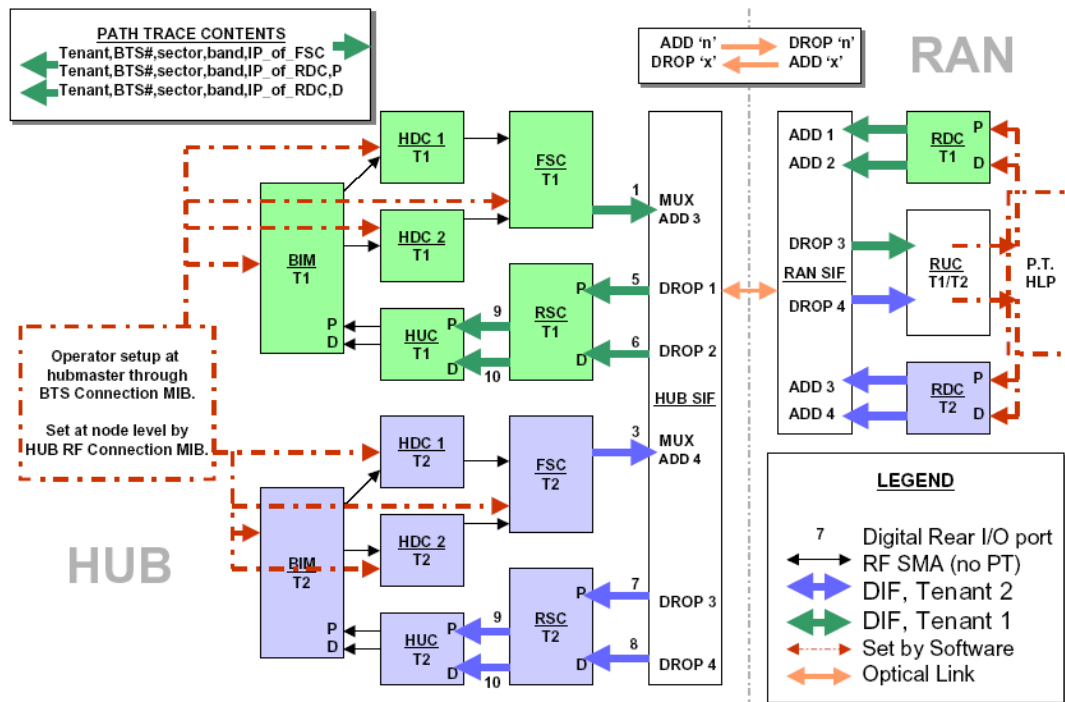


Figure 3-2. Tracing Pathtrace, Two Tenants

### 6.3.2 Pathtrace Forward Transmission

Though the BIM, HDC(s), and FSC all create the pathtrace string and report it in their MIB's, the FSC is the originator of the pathtrace string in the forward path of the system. The FSC HCP writes the pathtrace string to its FPGA, which transmits the pathtrace string through all eight (8) of its simulcasted outputs. Therefore, the pathtrace string will be routed to all RAN's belonging to this tenant.

### 6.3.3 Pathtrace Forward Reception

In the forward path, the SIF modules in the Hub that are connected to the FSC outputs, as well as the SIF's in the simulcasted RANs, simply pass-through the pathtrace strings from their inputs to their outputs. In addition, the SIF HCP's report the passed-through pathtrace strings in the SIF MIB for use by tenant processing and other higher-level processes, as described in Chapter 6.

In each of the simulcasted RAN's, the RUC module receives the pathtrace string into its FPGA from one of its two DIF input connections. The RUC HCP then reports the received pathtrace strings in its MIB for use by tenant processing and other higher-level processes, as described in Chapter 6.

### 6.3.4 Pathtrace Reverse Transmission

The RDC is the originator of the pathtrace string in the reverse paths of the system. However, it is desirable to maintain continuity between the forward and reverse pathtrace strings. To manage this, the Pathtrace Process that runs in the RAN CPUs is responsible for reading pathtrace strings from the RUC MIB, parsing out the Tenant ID sub-strings from the pathtrace strings, and writing the Tenant IDs into the MIB's of the RDC's that are associated with the RUC's.

The RDC HCP creates two new pathtrace strings (primary/diversity) starting with the Tenant ID that was provided in its MIB by the Pathtrace Process. The RDC HCP appends its own CPU IP Address to the pathtrace strings, and then appends the primary/diversity flags ("P" or "D"). Finally, the RDC process writes the pathtrace strings to its FPGA, which transmits the pathtrace strings out its two outputs (primary/diversity). The pathtrace strings are then transmitted back to the Hub reverse modules belonging to this tenant.

### 6.3.5 Pathtrace Reverse Reception

In the reverse path, the SIF modules in the RAN's that are connected to the RDC outputs, as well as the SIF's in the Hub, simply pass-through the pathtrace strings from their inputs to their outputs. In addition, the SIF HCP's report the passed-through pathtrace strings in the SIF MIB for use by tenant processing and other higher-level processes, as described in Chapter 6.

In the Hub, the RSC module receives the pathtrace strings from several RDC's into its FPGA from its DIF input connection. The RSC HCP reports the received input pathtrace strings in its MIB for use by higher-level processes, as described in sections below. The RSC has the added responsibility of determining the "majority inputs" to determine the most-prevalent input

pathtrace based on Tenant ID sub-strings. When the majority input is discovered, the RSC will parse the Tenant ID from one of the majority inputs, append its own CPU IP Address, and transmit the newly created pathtrace string to its two outputs (primary/diversity).

Finally, the HUC module receives the primary/diversity reverse pathtrace strings into its FPGA from its two DIF input connections. The HUC HCP then reports the received pathtrace strings in its MIB for use by higher-level processes, as described in the following sections.

### **6.3.6 Pathtrace Detection/Reporting**

On each node in the system, a Pathtrace Process is responsible for gathering up all the pathtrace strings reported in the HCP MIB's on its own CPU. The Pathtrace Process then reports all the discovered pathtrace strings in its own Pathtrace MIB, which indicates the HCP type, I2C/PCI address, MIB index, and pathtrace string value.

On each node in the system, a Node Paths Process is responsible for examining the Pathtrace MIB, identifying valid, complete, and stable Tenant IDs, and reporting the results in the Node Paths MIB in a manner that simplifies tenant processing algorithms.

On the Hub Master node, the Tenantscan process is responsible for examining the Node Paths MIB's on all nodes and determining whether the contents contain Tenant IDs that match configured tenants in the system. If so, then the Hostname and IP Address tables in the Tenant OAM are updated.

The Tenant processes in the Hub Master node are responsible for updating the Equipment MIB's on each node with the appropriate Tenant IDs and indices that are used on that node. The Equipment Process then acts as the middle-level interface to the tenant hardware, reporting status of all the hardware in the Status Table of the Equipment MIB and allowing hardware configurations to occur via the Control Table of the Equipment MIB. Tenant processing in the Hub Master node is the primary user of the Equipment MIB for status and control of tenant hardware. The details of this are described in more detail in the following section.

## **7 TENANT CONFIGURATION**

The Tenant OAM MIB is the primary interface for configuring the operating parameters of tenants in the Digivance CXD system. The Tenant OAM MIB is used exclusively at the Hub Master node, where any changes made to operating parameters are validated and pushed down to the proper node(s) by Tenant processing.

### **7.1 Setting Protocol**

*transceptTenantOAMTable.transceptTenantProtocol*

The Protocol field of the Tenant OAM MIB is an enumerated value, where the allowable selections are the protocols supported by the Digivance CXD system, currently. No Protocol (0), CDMA (1), TDMA (2), GSM (3), IDEN (4), AMPS (5), CW\_WB (6), CW\_NB (7). In Composite Mode, protocol need not be selected, and defaults to No Protocol (0).

## 7.2 Setting Channels

*transceptTenantOAMTable.transceptTenantChannelXVal*, where X = 1-8

Each Tenant sector in the Digivance CXD system can support from 1-8 channels. Each of these eight (8) channel values can be individually set in the Tenant OAM MIB. The valid range of values is based on the band and protocol selected for this tenant, per the specifications used to define each protocol. Refer to Chapter 4, Section 2. In Composite Mode, only channel 1 is active.

## 7.3 Setting Hub Measured Forward Gain

*transceptTenantOAMTable.transceptTenantHubMeasuredForwardGain*

This parameter is no longer used in the Digivance CXD system.

## 7.4 Setting RAN Measured Forward Gain

*transceptTenantOAMTable.transceptTenantRanXMeasuredForwardGain*, where X = 1-8

This parameter is no longer used in the Digivance CXD system.

## 7.5 Setting FSC Gain

*transceptTenantMoreControlsTable.transceptTenantMoreControlsFscOutputGain*

and

*transceptTenantMoreControlsTable.transceptTenantMoreControlsFscOutputGainOverride*

This feature allows the user to adjust FSC output gain outside of the default setting. The FSC Output Gain value is in tenths of a dB, and represents the amount of loss from full scale entered digitally in the forward path. For example, if a set of input signals had a peak to average value higher than 12 dB, an operator may wish to remove 3 dB of gain to allow for the extra peak power. The *transceptTenantMoreControlsTable.FscOutputGain* entry would be set to a value of -30 in such a case. The default state of FscOutputGainOverride is “disabled”. In its default state the system counts active FSC channels and governs FSC gain accordingly. To begin using a desired override value, set FscOutputGainOverride to “enabled”.

## 7.6 Setting RAN Forward Gain Offset

*transceptTenantOAMTable.transceptTenantRanForwardGainOffsetX*, where X = 1-8

The RAN Forward Gain Offset is a parameter in the Tenant OAM MIB that allows the target RAN Gains for this tenant to be adjusted. This effectively allows the cell coverage provided by a given RAN to be adjusted. There is one RAN Gain offset parameter in the Tenant OAM MIB for each RAN in a tenant simulcast group. The valid range of values for these parameters is -120 to +80, which is -12 to +8 dB in 1/10 dB units. Chapter 4, Section 3.

## 7.7 Setting Reverse Gain

*transceptTenantOAMTable.transceptTenantReverseGain*

The Reverse Gain parameter in the Tenant OAM MIB allows the Reverse Gain Target to be set. This value sets the gain for the entire reverse path - it is not separated into a separate Hub and RAN parameter as in the forward path. The valid range of values for this parameter is -100 to +300, which is -10 to +30 dB in 1/10 dB units. Refer to Chapter 4, Section 3.

## 7.8 Setting Forward Cable Loss

*transceptTenantOAMTable.transceptTenantForwardCableLoss*

This parameter is no longer used in the Digivance CXD system.

## 7.9 Setting Reverse Cable Loss

*transceptTenantOAMTable.transceptTenantReverseCableLoss*

Reverse Cable Loss is a parameter in the Tenant OAM MIB to allow the signal loss due to cabling between the base stations and the Digivance CXD system to be factored into the reverse gain management processing. This parameter has a valid range of values of 0 to 50, which is 0 to +5 dB in 1/10 dB units. The maximum cable loss between the BTS and the BIM is 5 dB. Refer to Chapter 4, Section 3.

## 7.10 Using Tenant Reset

*transceptTenantOAMTable.transceptTenantReset*

Tenant Reset is a parameter in the Tenant OAM MIB that will allow all of the hardware that is associated with a tenant to be reset. This functionality is not currently supported in the Digivance CXD software.

## 7.11 Enabling FGC / RGC

*transceptTenantOAMTable.transceptTenantForwardAGCDisable*

and

*transceptTenantOAMTable.transceptTenantReverseAGCDisable*

The Forward and Reverse Gain/Continuity Management processes can be disabled on a per tenant basis using the enable/disable parameters in the Tenant MIB. These MIB fields are enumerated types with values "Enabled" = 0, and "Disabled" = 1. The reason for the inverse boolean logic is so that the desired default values are set to be zero, which is the MIB default value.

## 7.12 Using Tenant Mode

*transceptTenantOAMTable.transceptTenantMode*

Tenant Mode is a parameter in the Tenant OAM MIB that will allow the tenant to be put into a special mode such as "disabled", or "test", or something similar. This functionality is not currently supported in the Digivance CXD software.



### 7.13 Enabling / Disabling Delay Compensation

*transceptTenantOAMTable.transceptTenantForwardDelayCompensationDisable*

and

*transceptTenantOAMTable.transceptTenantReverseDelayCompensationDisable*

The Forward and Reverse Delay Compensation processes, which balance the signal delay in a simulcast group, can be enabled/disabled using the associated parameters in the Tenant OAM MIB. These MIB fields are enumerated types with values "Enabled" = 0 and "Disabled" = 1. The reason for the inverse boolean logic is so that the desired default values are set to be zero, which is the MIB default value.

### 7.14 Setting Forward / Reverse Delay Skew

*transceptTenantOAMTable.transceptTenantForwardSkew*

and

*transceptTenantOAMTable.transceptTenantReverseSkew*

The delay skew used in the Forward/Reverse Delay Compensation processes can be adjusted using the associated Tenant OAM MIB parameters. Refer to Chapter 7, Sections 3 and 4 for details.

The valid range of values for the Forward/Reverse Delay Skew parameters is 0-10000, in units of nanoseconds (0-10 usecs). Default is 2000.

### 7.15 Enabling / Disabling RAN slots

*transceptTenantOAMTable.transceptTenantRanDisableX*, where X = 1-8

The RAN paths belonging to a tenant can be disabled using the RAN Enable/Disable parameters of the Tenant OAM MIB. Doing so will disable the PA in the RAN. These MIB fields are enumerated types with values "Enabled" = 0, and "Disabled" = 1. The reason for the inverse boolean logic is so that the desired default values are set to be zero, which is the MIB default value.

Example:

To disable RAN 3 in a simulcast, set *transceptTenantOAMTable.transceptTenantRANDisable3* to a "1" (disabled).

### 7.16 Forward/Reverse Target Delay

*transceptTenantTargetDelayTable.transceptTenantForwardTargetDelay*

and

*transceptTenantTargetDelayTable.transceptTenantReverseTargetDelay*

The Forward/Reverse Target delays can be adjusted using the Tenant Forward/Reverse Target Delay entries in the Tenant OAM MIB. The valid range of values for the Forward/Reverse target Delay is 12,000 to 150,000 ns with a default of 100,000 ns being used if the target delay is not configured. Refer to Chapter 7, Sections 3 and 4 for details of the usage of these fields.

## 7.17 FSC Attenuator Offsets

*transceptTenantCalTable.transceptTenantFscAttenX*

If not using Composite Mode, there is a step during Forward RF Path Balancing that requires that the FSC Digital path attenuators to be adjusted. These adjustments need to be made in the Tenant OAM MIB in the FSC Attenuator Offset fields, of which there is one per channel in the Tenant OAM MIB with the naming convention. The values that are set in the Tenant OAM MIB will be pushed down to the appropriate FSC MIB Attenuator fields. Doing these settings in the Tenant OAM MIB will allow consistency with the maintenance of configuration data. Refer to Section X for further details on usage.

## 7.18 Target Simulcast Degree

In order for the Digivance CXD software to determine the correct number of tenant paths throughout the system, it is necessary for the Digivance CXD software to be provided with the target simulcast degree. This will allow the Tenant process to properly determine and report missing boards and path conditions and quantities. The Tenant Simulcast Degree field in the Tenant OAM MIB is used to configure this parameter. This MIB parameter accepts values ranging from 1-8, the range of simulcasting supported in Digivance CXD on a per sector basis.

## 7.19 Module Attenuators

In order to be consistent with all other configuration parameters in the system, and to ensure that configuration data is properly managed, the Tenant OAM MIB contains several parameters to allow the configuration of tenant module attenuators. When configured in the Tenant OAM MIB, tenant processing will push these attenuators to the appropriate HCP MIB. It is important to note that it is not always desirable to modify HCP attenuators, and should only be done per operating instructions. It is also important to note that the attenuator values configured in the Tenant OAM MIB will supercede (and therefore overwrite) those configured in the HCP MIB's. The following is the list of all supported tenant attenuators in the Tenant OAM MIB:

- *TransceptTenantGenTwoTable.transceptTenantHdcZAttenOffset* - Z= Module 1-2. For V1 HDC's only.
- *TransceptTenantGenTwoTable.transceptTenantRucYAttenOffset* - Y = RAN 1-8.
- *TransceptTenantGenTwoTable.transceptTenantRdcYAttenOffsetPrimary* - Y = RAN 1-8.
- *TransceptTenantMoreAttenTable.transceptTenantRdcYAttenOffsetDiversity* - Y = RAN 1-8.
- *TransceptTenantMoreAttenTable.transceptTenantBimForwardAttenZOffset* - Z = Path 1-2. For V2 BIM's only.
- *TransceptTenantMoreAttenTable.transceptTenantHdcChXAttenOffset* - X = Channel 1-8. For V3 HDC's only.

## 8 MANAGING THE TENANT OAM ADDRESS AND HOSTNAME TABLES

Within the Tenant OAM MIB, there are two (2) tables used to capture the current IP Addresses and Hostnames of all CPUs that are associated with a given tenant sector. The ordering of the CPUs in the MIB tables is such that the RAN CPUs are listed first from 1-8, followed by the Hub CPUs. The RAN ordering from 1-8 is important so that the RAN CPUs can be correlated to the RAN ID values used throughout the Tenant OAM MIB.

### 8.1 RAN Ordering

The IP Address and Hostname tables in the Tenant OAM MIB indicate which RAN, based on IP address and hostname, corresponds to RAN X, where X is the RAN ID (1-8).

Tenant processing uses a least-recently-used scheme to determine the RAN ID to assign to newly discovered RAN's. When Tenant processing discovers new RAN's that contain hardware associated with that tenant (based on Tenant ID of pathtrace string), the new RAN is assigned the next sequential "never-been-used" RAN ID, a value from 1-8. If there are no RAN IDs that have never been used, then Tenant processing will find the least-recently-used RAN ID and assign that ID to the newly discovered RAN.

The RAN ID is important because it lets the user of the Tenant OAM MIB determine which RAN corresponds to the RAN-specific MIB parameters, such as:

*TenantRanDisableX*, *TenantRanXForwardMeasuredGain*

and

*TenantRanForwardGainOffsetX* where X is the RAN ID, a value from 1-8.

The RAN ID assignments will be persistently maintained through resets of the Hub Master CPU and other CPUs in the network, which will allow the NMS to program the RAN IDs when new RAN's are added to the tenant simulcast group. In the future, the RAN ID assignments will not be persistent through resets of the network nodes, which will require that the NMS automatically correlate RAN ID to RAN CPU relationships.

### 8.2 Bracketing of Lost RAN's

When a RAN CPU is removed from the network, or if Tenant processing is unable to communicate with one of its RANs, then that RAN ID in the Hostname table is bracketed. For example *hostname* would be reported as [*hostname*]. In addition, the RAN ID in the Address table is also reported in a different fashion when a RAN is "lost". The IP address is bracketed, with the IP address string being replaced by another form of the number. For example, 172.20.1.248 could be replaced by [1921681.248]. The point is that if the IP address reported in the Address table is not a valid combination of 4 octet values with decimal points separating the octets, then that RAN should be considered not present.

### 8.3 Clearing of RAN's

In order to facilitate swap outs of RAN CPUs, it is possible for the RAN Hostname values in the Hostname table of the Tenant OAM MIB to be cleared by writing a NULL string into the MIB from the NMS. Doing so will allow that RAN ID to be cleared, and will allow the next RAN CPU discovered to occupy that RAN ID.

## 9 HUB NODE ACCESS/MANAGEMENT

### 9.1 Managing Hub Nodes

The Hub in a Digivance CXD 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. At installation time, each hostname, as written on the front tag of each CPU, must be recorded in conjunction with its physical location. This information is used when the operator fills in the Hub Node MIB, which is discussed in detail below. Digivance CXD Hub naming conventions are also discussed below.

The Hub Node MIB correlates Hub node IP addresses with their hostnames and physical locations. It resides solely at Hub Master nodes. Refer to Section 11.1 for details.

### 9.2 Identification using the Network IP Receiver/Sender

The Digivance CXD Hub Master node dynamically keeps track of which nodes are under its control using a script called NIPRS (Network IP Receiver/Sender). It receives an IP and hostname from each element in the subnet it controls via the client functionality of NIPR/S, which runs on all "slave" nodes. NIPR/s senses any changes to its list of slave nodes, and updates the Hub Master DNS accordingly. The NIPR/S script is also a key component to maintaining the HUB/RAN Node MIB's and, ultimately, tenant processing as a whole, since it is the mechanism by which the HUB/RAN Node MIB entries are filled.

There are two main ways to access the output of NIPR/S for use in the identification of related nodes. The most accessible way is to utilize SNMP to view the Hub Node MIB and RAN Node MIB at the Hub Master node. To get an unbroken list of Digivance CXD IP addresses that the Hub Master is currently servicing, telnet into the Hub Master node on port 7401. No user name or password is necessary. The output format is a series of text strings, each containing an IP preceded by a "+" or "-" and terminated with a line feed. The Hub Master is always the first entry in the list. An example of a typical output for a five-node system is shown in Figure 3-3.

```
+172.20.1.1
+172.20.1.249
+172.20.1.250
-172.20.1.246
+172.20.1.247
+172.20.1.242
```

**Figure 3-3. Typical NIPR/S Output Using Telnet**

The “+” indicates the IP has been added to the list. A “-“ would indicate the IP has been removed from the list. This would occur, for example, if the communication link to that node was removed due to a power shutdown or other disruption.

### 9.3 Accessing Nodes Locally

Nodes can be accessed locally through the serial link. The required hardware is as follows:

- Terminal with serial interface and terminal software such as Tera-Term Pro or Hyperlink.
- RS-232 cable 9 pin D shell male to male type.
- Adapter for the Digivance CXD CPU low profile I/O connector (DB-9F to RJ-11).

Once the link is made, run the terminal software. If a login prompt is not already available in the terminal window, hit enter a few times to bring it up. Then follow a normal login procedure.

### 9.4 Accessing Nodes via TCP/IP

To perform some installation maintenance activities, the network operator will need to log into Digivance CXD nodes. Each node runs a daemon for Telnet, File Transfer Protocol (FTP), and Virtual Network Connections (VNC). Depending on the LAN’s DNS configuration, a user may or may not be able to use hostnames (instead of literal IP addresses) when accessing Digivance CXD nodes. Nodes can always be accessed by IP address. The three access types are available for Windows and Unix strains.

There are two default user accounts that come standard in the Digivance CXD network. The “operator” account has access to the Digivance CXD binaries and is used for regular maintenance. The “root” account has full access privileges to the entire file system. In addition, the “operator” account has “sudo” privileges, which may be modified by the network operator to tailor operator access. To learn more about “sudo”, log onto any Linux operating system and type “man sudo” at the prompt. Note that, among other privileges, a “root” user can create more user accounts on each node.

## 9.5 Using a Third Party Network Management System with Digivance CXD

Digivance CXD control and monitoring is executed via Simple Network Management Protocol (SNMP). As such, any Network Management System (NMS) based on SNMP will be compatible with the Digivance CXD system. However, not all NMS products are the same. While it is up to the operator to determine which NMS is right for their needs, it is recommended that the chosen NMS will have the following features:

- Auto-polling
- The NMS must regularly poll all nodes for MIB entry updates.
- The NMS must regularly search for new nodes on its network.
- Graphical User Interface for data display and manipulation
- At a minimum, a MIB browser capable of SNMP level 2 sets and gets, coupled with a node map generator, would suffice.
- Ability to output poll data to a database for customizable GUI operations such as user accounts and data sorting is strongly recommended.
- Trouble ticket generation
- The Digivance CXD system outputs a wealth of raw event information. It is up to the NMS to determine what alarms are generated, and how to dispatch resources to rectify the situation. For a complete list of Digivance CXD faults, see Chapter 6 of this document.
- E-mail, pager, and cell phone notification methods are recommended for a user-defined subset of fault conditions.
- Scheduling tables are a plus for those operators who are not on call 24 hours a day.

## 10 CONFIGURING THE HUBMASTER NODE

A correctly configured Hub Master Node is the key to an operational Digivance CXD network. To simplify this task, the Digivance CXD system software includes the `configure-hubmaster` script. The use of this script is described in Section 10.1. In addition to the common node tasks throughout this document, the Hub Master has the following responsibilities:

- Network Timing Protocol Daemon (`/usr/sbin/ntpd`), synchronous with GPS input.
- Dynamic Host Configuration Protocol server (`/usr/sbin/dhcpd3`).
- Domain Name Server (`/usr/sbin/named`).
- Node IP Receiver/Sender (`/usr/sbin/niprs`) server-side properties discussed in Section 9.2.
- Digivance CXD Tenant processing (`/usr/bin/tenantscan` and `/usr/bin/tenant`).

## 10.1 Utilizing The Configure-Hubmaster Script

Use the following procedure to invoke the configure-hubmaster script:

- Login locally to the target node as operator
- Type “sudo /usr/sbin/configure-hubmaster” and enter the password when prompted.
- Enter the information as shown in the following paragraphs.

### 10.1.1 IP Address / Netmask

At the IP prompt, enter the static IP address that has been assigned to this Hub Master node. This is a crucial step, as it not only defines the node’s identity, but, in conjunction with the netmask input, it also defines the subnet it services. It is advised that the node IP be in the form XXX.YYY.ZZZ.1, to match the default Digivance CXD DHCP settings. The netmask prompt further defines which subnet the Hub Master node will service. The default is 255.255.255.0, or a “class C netmask”. This is the recommended netmask value for the Digivance CXD system.

### 10.1.2 DHCP Address Range

The DHCP address range portion of the script first prompts the operator for the beginning of the range. It uses the IP address and netmask input described previously to provide a default lower limit of XXX.YYY.ZZZ.3. When in doubt, depress the enter key to select the default lower limit. Likewise, a default upper limit will be generated, servicing nodes up to and including XXX.YYY.ZZZ.250. Again, unless a different upper limit is desired, simply press the enter key to use the default value. For examples involving changing these limits, see Section 10.2.2

### 10.1.3 Default Gateway / Router

At the prompt, enter the IP address of the router interfacing with the node being configured. If there is to be no upstream router, enter in the IP address of the Hub Master node itself. Failure to enter a valid IP address in this field will result in the improper network operation of the Digivance CXD System.

### 10.1.4 Hub Master Domain

Each Hub Master node requires its own domain to service. This is to allow multiple Hub Master nodes to use the same upstream DNS, and also negates the problem where slave nodes try to talk to the “wrong” Hub Master. The default value is Digivance CXD, which is suggested to be changed to something more descriptive in the target network. At a minimum, numbering the domains serially will achieve the desired result (i.e. Digivance CXD, Digivance CXD-4XD-G22, etc.).

### 10.1.5 DNS Forwarding

The script will prompt “Enter a list of upstream DNS servers, one per line: (control-d when done)” to set up DNS forwarding. It is expecting as input the IP address of each Domain Name Server that the Hub Master node can connect to. If there are no upstream DNS servers, leave this entry blank. Hit CNTRL-D when finished entering DNS upstream servers.



**Note:** *It is advisable to reboot the Hub Master node once the script has been run to ensure that the modifications made via configure-hubmaster are in effect.*

### 10.1.6 NTP Service

The script will prompt "Enter a list of NTP servers, one per line: (control-d when done)" to set up NTP services, which will allow the data/time to be pushed to this domain from the configured servers. If none are specified, then the Hub Master will use its current time as the default.

### 10.1.7 SNMP Trap Sinks

The script will prompt "Enter a list of SNMP v1 trap-sinks, one per line: (control-d when done)" in order to set up any SNMP-V1 trap receivers that traps should be transmitted to. The script will then prompt "Enter a list of SNMP v2 trap-sinks, one per line: (control-d when done)" in order to set up any SNMP-V2 trap receivers that traps should be transmitted to.

Any number of trap-sinks can be configured, though the quantity should be kept to a minimum in order to minimize processor load on network nodes. Also, SNMP V1 and V2 trap-sinks can be configured simultaneously within the same domain. In the event that SNMP-V1 trap-sinks are configured, the Digivance CXD-4XD-G1 software will convert the SNMP-V2 traps to SNMP-V1 traps before transmitting them.

## 10.2 Using Dynamic Host Configuration Protocol with Digivance CXD

All Hub and RAN nodes, except the Hub Master node, utilize DHCP to obtain their IP addresses. Each Digivance CXD Hub Master comes standard with a DHCP server to configure its subnet. The following sections explain its use.

### 10.2.1 Using The Provided Hub Master DHCP

The Digivance CXD Hub Master node comes standard with DHCP already activated. When employing multiple Hub Master nodes, it is important to run the configure-hubmaster script as outlined in Section 10.1 to prevent collisions.



### 10.2.2 Incorporating Existing LAN DHCP

Using a pre-existing LAN DHCP server is ideal when the Digivance CXD network only contains one Hub Master node. In this configuration, there is no need for a router between the Hub Master and the rest of the LAN, since all nodes are on the same subnet. To use this configuration, the Hub Master DHCP must be disabled using the following steps:

- Login to Hub Master node
- Type “sudo rm /etc/init.d/dhcp3-server” and enter your login password at the prompt. This stops the DHCP server from being run.
- Type “sudo killall dhcpd3” to stop the current service.
- Type “sudo reboot” to reboot the machine.

As the Hub Master is not configured to be a DHCP client, it requires a static IP that must be outside the range of the existing LAN DHCP. This may mean narrowing the existing DHCP server’s address range. For example, take the case where the original DHCP range is 172.20.88.3 through 172.20.88.254 inclusive, and assume it assigns these addresses from the upper limit towards the lower. Also assume that there’s a router at 172.20.88.1 and another static IP device at 172.20.88.2. The Hub Master needs a static IP, but the DHCP is serving all the “free” addresses in that subnet. To avoid DHCP collisions and the perturbation of preexisting addresses, the operator would increase the DHCP server’s lower address limit from 172.20.88.3 to 172.20.88.4, and set the Hub Master to be IP 172.20.88.3.

It is also important to have a mechanism in place to update the LAN DNS with the Hub Master IP address, so that the Digivance CXD nodes know where to send data. Since the Hub Master IP is static, this can be manually entered at installation time.

The setup becomes more complicated when multiple subnets are introduced. However, it is recommended that in such a case the Hub Master DHCP server be utilized instead.

### 10.2.3 Using Domain Name Service With Digivance CXD

The DNS offers a way to represent nodes using hostnames instead of IP addresses. This is an important relationship when using DHCP, since the hostnames are more likely to be static than their associated IP addresses. The Digivance CXD Hub Master node comes standard with a DNS which services its related subnet. In addition, the Hub Master node can employ DNS forwarding to utilize a pre-existing LAN DNS. The following sections outline the steps necessary to use the Digivance CXD DNS.

### 10.2.4 Using The Hub Master DNS

The Digivance CXD DNS is automatically updated via NIPR/S as outlined in Section 9.2, so there is no need to manually configure it. As this process does not interfere with existing upstream DNS activities, it need not be disabled.

### 10.2.5 Incorporating Existing LAN DNS

The method of incorporating an existing LAN DNS begins with configuring the Hub Master DNS forwarding as outlined in Section 10.1.5 and continues with some maintenance at the upstream DNS. At a minimum, the upstream DNS needs to be updated with each Hub Master node's IP address and full hostname (including its domain). Ideally, this maintenance would be automated, and the RAN nodes would also be maintained in the upstream DNS. Implementations of this are as varied as the networks being maintained, and may need to be custom designed by a network administrator.

## 11 CONFIGURING THE HUB "SLAVE" AND RAN NODES

The Digivance CXD system takes care of networking concerns for the Hub "Slave" and RAN nodes, leaving only some clerical steps to take to configure these nodes. These clerical steps are encompassed by the Hub and RAN Node MIB's.

### 11.1 Managing The Hub Node MIB

This MIB correlates Hub node IP addresses with their hostnames and physical locations. It resides solely at Hub Master nodes. It is comprised of the following elements:

#### 11.1.1 Site ID

*transceptHubNodeTable.transceptHubNodeSiteID*

The Site ID designates the physical location of the HUB. Often, wireless operators already have site IDs laid out for their markets and BTS installations, such as "Memphis203" or "Cell29PA", and these designators work well for pinpointing the location of the HUB. GPS coordinates or road names also work well. The Site ID can be up to 64 characters long.

#### 11.1.2 CPU Rack ID

*transceptHubNodeTable.transceptHubNodeCPURackID*

Hub Racks must be given unique identifiers using the CPU Rack ID field. This can be as simple as numbering Hub Racks from 1...N, numbering them based on their serial number, or coming up with some other naming convention. Once a plan is adopted, it is highly recommended that the racks be labeled accordingly at installation. The CPU Rack ID is limited to 15 characters.

#### 11.1.3 CPU Chassis ID

*transceptHubNodeTable.transceptHubNodeCPUChassisID*

Chassis in a rack also need to be uniquely identifiable by using the CPU Chassis ID field. The convention is to number the chassis based on the highest U-number they occupy in the rack. The CPU Chassis ID can be comprised of up to 15 characters.

#### 11.1.4 Hostname

*transceptHubNodeTable.transceptHubNodeHostname*

This entry shows the hostname of the CPU occupying a specific row of the Hub Node MIB. This entry is automatically set up by Digivance CXD system software. Changing hostnames on Digivance CXD nodes is not recommended, but can be accomplished by logging into the target node.

#### 11.1.5 IP Address

*transceptHubNodeTable.transceptHubNodeIPAddress*

This entry displays the current IP address for the CPU occupying a specific row in the Hub Node MIB. This entry is automatically set up by Digivance CXD system software. For more information on the NIPR/S function, see Section 9.2.

#### 11.1.6 Clean

*transceptHubNodeTable.transceptHubNodeClean*

The Hub Node MIB contains a history of any Digivance CXD CPU ever seen by the Hub Master. If a CPU is swapped out as part of a maintenance activity, the old entry will still exist. To remove old and unwanted node information from this MIB, the operator must set the “Clean” field to 1. In a matter of seconds, the old node information will be removed. No further action is required. Note if the node is valid, it will re-appear within seconds, even if it is cleared.

#### 11.1.7 Setting the RF Rack/Chassis ID

*transceptHubNodeRfTable.transceptHubNodeRfRackID*

and

*transceptHubNodeRfTable.transceptHubNodeRfChassisID*

The Hub CPU may manage the I2C communications to the chassis that contains the RF equipment belonging to some (1 – 2) of the tenants. The chassis and its rack are configured with the Hub Node RF Rack ID and the Hub Node RF chassis ID fields. As not all Hub CPU's control RF chassis, this field is optional. If used, the allowable values are strings of 1 – 16 characters. The Hub configuration process will push these values to the Tenant Node MIB of the CPU being configured as well as to the previously used locations in the BTS Connection MIB.

#### 11.1.8 Setting The GPS Coordinates (Hub Master Only)

*(transceptHubNodeGpsCoordTable.transceptHubNodeGpsLongitude)*

and

*(transceptHubNodeGpsCoordTable.transceptHubNodeGpsLatitude)*

For cases where a GPS receiver is not present and it is desired to manually enter the GPS coordinates, the Hub Node MIB contains two MIB fields to configure the GPS longitude and latitude settings. Since only the Hub Master node in the Digivance CXD system contains a GPS receiver, these MIB fields will not be used for Hub Slave nodes. These MIB fields are bi-directional: the Digivance CXD software (Hub Config Process) checks for the presence of a GPS on the Hub Master node - if the GPS is present, then the GPS longitude/latitude values will be automatically populated from the Hub Master Network Node MIB. If the GPS is not present, then the values will be pushed to the Network Node MIB of the Hub Master node.

When entering in the GPS longitude and latitude values, the format is a string representing degrees as follows:

(-)xxx.yyyyyy, where the leading minus sign is optional.

## 11.2 Managing the RAN Node MIB

This MIB correlates RAN node IP addresses with their hostnames and physical locations. It also documents where RF connections are made in each RAN. It resides solely at Hub Master node. It is comprised of the following elements:

### 11.2.1 IP Address

This entry (*transceptRanNodeTable.transceptRanNodeIPAddress*) displays the IP Address of each RAN attached to the Hub Master node. RAN IP addresses are assigned by DHCP. This entry is automatically entered by Digivance CXD system software.

### 11.2.2 Hostname

*transceptRanNodeTable.transceptRanNodeHostname*

This entry displays the hostname of each RAN attached to the Hub Master node. This entry is automatically entered by Digivance CXD system software. Changing the default hostname is not recommended, but can be accomplished.

### 11.2.3 Pole Number

*transceptRanNodeTable.transceptRanNodePoleNumber*

This entry displays the number of the pole on which each RAN is installed. In conjunction with the Site ID, this is the mechanism used to pinpoint any RAN's physical location. GPS can also be used, where available. The pole number may be 15 characters long.

### 11.2.4 Site ID

*transceptRanNodeTable.transceptRanNodeSiteID*

This entry displays the RF Network's Site ID where each RAN is installed. In conjunction with the Pole Number, this is the mechanism used to pinpoint any RAN's physical location. GPS can also be used, where available. The Site ID may be 64 characters long.

### 11.2.5 RucXPaY Connection

*transceptRanNodeTable.transceptRanNodeRucXPaYConnection, where X=1-3, Y=1-2*

These entries manually record the RF connection path between the RAN UpConverter's PA outputs and the antenna. For example, if the PA attached to RUC A1's "1/3" output is connected to a PCS quadplexer through the B-band port, then *transceptRanNodeTable.transceptRanNodeRuc1Pa1Connection* should be set to "pcsBQuadplexer". This data is best gathered at installation time. Repeat for all RUCs and PAs as necessary.

### 11.2.6 RdcZ Multicoupler Connection

*transceptRanNodeTable.transceptRanNodeRdcZMulticouplerConnection, Z=1-5*

This feature is no longer supported by the Digivance CXD system. This field defaults to "unconnected".

### 11.2.7 Invalid

*transceptRanNodeExtTable.transceptRanNodeExtInvalid*

This entry resides in the "expansion" table of the RAN Node MIB. If a node in the network that is now found to be a Hub node resides in the RAN Node MIB (i.e. was previously resident in a RAN), the Invalid field in the RAN Node MIB will be set to true. This will alert the NMS to clear that node entry in the RAN Node MIB.

### 11.2.8 Clean

*transceptRanNodeExtTable.transceptRanNodeExtClean*

This entry resides in the expansion MIB table of the RAN Node MIB. The RAN Node MIB keeps a history of every RAN ever seen by the Hub Master node. At times these entries will become invalid as CPUs are swapped out, etc. To remove old and unwanted node information from this MIB, the operator must set the "Clean" value to 1. In a matter of seconds, the old node information will be removed. No further action is required. Note that if the node is present and valid, it will re-appear within seconds, even if it is cleared.

### 11.2.9 RAN Disable

*transceptRanNodeDisableTable.transceptRanNodeDisableRanState*

This entry in the RAN Node MIB allows a given RAN to have all of its PA's disabled. By setting this field to "disabled", the Digivance CXD software will automatically push the value down to the Network Node MIB on the RAN in question, which will cause all PA's to be turned off. If this value is set to "enabled", then the RAN Disable states that are maintained on a per-tenant basis in the Tenant OAM MIB will be used instead.

\*Note: This overrides the tenant OAM MIB setting.

### 11.2.10 Setting The GPS Coordinates

*transceptRanNodeGpsCoordTable.transceptRanNodeGpsLongitude*

and

*transceptRanNodeGpsCoordTable.transceptRanNodeGpsLatitude*

For cases where a GPS receiver is not present on a given node and it is desired to manually enter the GPS coordinates, the RAN Node MIB contains two MIB fields to configure the GPS longitude and latitude settings. These MIB fields are bi-directional: the Digivance CXD software (Hub Config Process) checks for the presence of a GPS on the RAN nodes - if the GPS is present on a given node, then the GPS longitude/latitude values for that node will be automatically populated from that RAN's Network Node MIB. If the GPS is not present, then the values will be pushed to the Network Node MIB of that RAN node. When entering in the GPS longitude and latitude values, the format is a string representing degrees as follows:

(-)xxx.yyyyyy, where the leading minus sign is optional.

## SECTION 4: BTS INTEGRATION

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### 1 BTS VALIDATION

Prior to connecting the base station to the Digivance CXD HUB, the host BTS should be tested to assure the BTS is operating per the manufacturer's specification.

### 2 CHANNEL SELECTION

The required channels are to be set in the transectTenantChannelXVal (X=1-8) fields of the Tenant OAM MIB for the appropriate Tenant sector. The following sections define the different channel designators used by Digivance CXD for the different bands and protocols. Up to eight channels can be defined.

#### 2.1 iDEN – SMR

BLOCK	VALID	CHANNEL #	MOBILE TX (MHZ)	BTS TX (MHZ)
SMR iDEN	No	1-160	806.0125 + 0.025 * (N-1)	851.0125 + 0.025 * (N-1)
	Yes	161-600	806.0125 + 0.025 * (N-1)	851.0125 + 0.025 * (N-1)

## 2.2 CDMA Cellular – EIA/TIA-97

BLOCK	VALID	CHANNEL #	MOBILE TX (MHZ)	BTS TX (MHZ)
A''	No	991-1012	824.040-824.670	869.040-869.670
	Yes	1013-1023	824.700-825.000	869.700-870.000
A	Yes	1-311	825.030-834.330	870.030-879.330
	No	312-333	834.360-834.990	879.360-879.990
B	No	334-355	835.020-835.650	880.020-880.650
	Yes	356-644	835.680-844.320	880.680-889.320
	No	645-666	844.350-844.980	889.350-889.980
A'	No	667-688	845.010-845.640	890.010-890.640
	Yes	689-694	845.670-845.820	890.670-890.820
	No	695-716	845.850-846.480	890.850-891.480
B'	No	717-738	846.510-847.140	891.510-892.140
	Yes	739-777	847.170-848.310	892.170-893.310
	No	776-799	848.340-848.970	893.340-893.970

## 2.3 GSM 850

BLOCK	VALID	CHANNEL #	MOBILE TX (MHZ)	BTS TX (MHZ)
GSM 850	Yes	128-251	824.200 + 0.200 * (N-128)	869.200 + 0.200 * (N-128)

## 2.4 TDMA 800

BAND	CHANNELS	MOBILE TX	BTS TX
A''	991	824.040	869.040
	1023	825.000	870.000
A	1	825.030	870.030
	333	834.990	879.990
B	334	835.020	880.020
	666	844.980	889.980
A'	667	845.010	890.010
	716	846.480	891.480
B'	717	846.510	891.510
	799	848.970	893.970



## 2.5 TDMA 1900

BLOCK	VALID	CHANNEL #	MOBILE TX (MHZ)	BTS TX (MHZ)
TDMA 1900	Yes	2-1998	1850.040 + 0.030 * (N-2)	1930.080 + 0.030 * (N-2)

## 2.6 GSM 1900

BLOCK	VALID	CHANNEL #	MOBILE TX (MHZ)	BTS TX (MHZ)
GSM 1900	Yes	512-810	1850.200 + 0.200 * (N-512)	1930.200 + 0.200 * (N-512)

## 2.7 CDMA 1900

BLOCK	VALID	CHANNEL #	MOBILE TX (MHZ)	BTS TX (MHZ)
CDMA 1900	Yes	1-1200	1850.000 + 0.050 * (N-1)	1930.000 + 0.050 * (N-1)

## 3 PATH BALANCING

This section defines the procedure for balancing the forward and reverse paths for a given Tenant Sector. The following table outlines the Standard Digivance CXD Configuration for a balanced forward and reverse path which includes the # of RF channels and simulcast ranges.

Note: When adjusting power and attenuator levels in the Digivance CXD MIBs, values are represented in 0.1 dB increments (e.g. -100 indicates -10.0 dBm).

**Table 4-1. Standard Digivance CXD Configuration**

BAND	PROTOCOL	# RF CHANNELS	MAX SIMULCAST
PCS	CDMA	3	8
PCS	GSM	4	5
PCS	TDMA	6	6
Cell	CDMA	3	8
Cell	GSM	4	5
Cell	TDMA	6	6
SMR	IDEN	6	6

For Tenants that require a different number of RF channels, then the forward PA output powers are changed using the following equation:

- Forward PA output change =  $10 \cdot \log_{10}(\text{baseline \# RF channels} / \text{new \# RF channels})$ .

For example, if a PCS/CDMA WSP requires 6 RF channels, then the forward PA output power per RF channel is adjusted by  $10 \cdot \log_{10}(3/6) = -3.0$  dB. The per RF channel power is changed from 34 to 31dBm.

If the operator requires a different reverse link budget, then the simulcast # can be changed. The equation for this calculation is:

- New simulcast # =  $(\text{baseline simulcast \#}) / 10^{(\text{Reverse link budget change}/10)}$

For example, if a Cellular/CDMA WSP requires a change of +3dB in the reverse link budget, then the simulcast # is changed to  $(8 / 10^{(3/10)}) = 4$ ;

The following tables define the RAN output power as a function of:

- Carrier count
- Maximum composite PA output power
- RAN configuration (4 or 8 Tenant RAN)

All numbers are in dBm except for carrier counts.

**Table 4-2. RAN Output - 4 Tenant**

BAND	PCS	PCS	PCS	PCS	CELL	CELL	CELL	CELL	SMR
PROTOCOL	CDMA	GSM	TDMA	EDGE	CDMA	GSM	TDMA	EDGE	IDEN
# Carrier									
1	40.5	41.5	41.5	41.5	37.5	38.5	38.5	38.5	38.5
2	37.5	38.5	38.5	38.5	34.5	35.5	35.5	35.5	35.5
3	35.7	36.7	36.7	36.7	32.7	33.7	33.7	33.7	33.7
4	34.5	35.5	35.5	35.5	31.5	32.5	32.5	32.5	32.5
5	33.5	34.5	34.5	34.5	30.5	31.5	31.5	31.5	31.5
6	32.7	33.7	33.7	33.7	29.7	30.7	30.7	30.7	30.7
7	32.0	33.0	33.0	33.0	29.0	30.0	30.0	30.0	30.0
8	31.5	32.5	32.5	32.5	28.5	29.5	29.5	29.5	29.5

Note: Recommended carrier counts (by band/protocol) are in the grayed boxes

**Table 4-3. RAN Output - 8 Tenant**

BAND	PCS	PCS	PCS	PCS	CELL	CELL	CELL	CELL	SMR
PROTOCOL	CDMA	GSM	TDMA	EDGE	CDMA	GSM	TDMA	EDGE	IDEN
# Carrier									
1	39.5	40.5	40.5	40.5	36.5	37.5	37.5	37.5	37.5
2	36.5	37.5	37.5	37.5	33.5	34.5	34.5	34.5	34.5
3	34.7	35.7	35.7	35.7	31.7	32.7	32.7	32.7	32.7
4	33.5	34.5	34.5	34.5	30.5	31.5	31.5	31.5	31.5
5	32.5	33.5	33.5	33.5	29.5	30.5	30.5	30.5	30.5
6	31.7	32.7	32.7	32.7	28.7	29.7	29.7	29.7	29.7
7	31.0	32.0	32.0	32.0	28.0	29.0	29.0	29.0	29.0
8	30.5	31.5	31.5	31.5	27.5	28.5	28.5	28.5	28.5

Note: Recommended carrier counts (by band/protocol) are in the grayed boxes

### 3.1 Forward Path Balancing

Note that for all steps below the value of "X" in MIB fields refers to the Channel 1-8, the value of "Y" in MIB fields refers to RAN ID 1-8, and the value of "Z" in MIB fields refers to module/path.

#### 3.1.1 Initialization

The next section outlines the preparation for balancing the forward output.

1. Set all BIM attenuator offsets to 0 dB for this Tenant Sector using the *transceptTenantMore AttenTable.transceptTenantBimForwardAttenZOffset* fields for his tenant's BIM module.
2. Using the *transceptTenantCalTable.transceptTenantFscAttenX* fields of the Tenant OAM MIB, set all FSC digital attenuations to 0 dB (8 channels)
3. Using the *transceptTenantOAMTable.transceptTenantRanDisableY* fields of the Tenant OAM MIB, disable all RAN PAs for this Tenant Sector
4. Using the *transceptTenantOAMTable.transceptTenantForwardAGCDisable* field of the Tenant OAM MIB, disable Forward Autogain on the Hub and all RANs on this Tenant Sector

### 3.1.2 HDC Setup

This section outlines the procedure for balancing the Hub forward output.

1. Using the *transceptTenantOAMTable.transceptTenantChannelXVal* fields of the Tenant OAM MIB, enable the first (X=1) BTS RF channel (disable all other channels by entering zero into Tenant O&M MIB)
2. Record RMS power reported by the FSC in the *transceptTenantFscPowerTable.transceptTenantFsc1OutputPower* field of the Tenant OAM MIB.
3. Disable current channel and enable next RF channel
4. Repeat steps 2-3 for all remaining BTS carriers (up to 8).
5. From recorded power for all RF channels, find the highest power level.
6. Enable highest power RF channel (disable all other RF channels)
7. Using the *transceptTenantMoreAttenTable.transceptTenantBimForwardAttenZOffset* fields in the Tenant OAM MIB, change BIM attenuator offsets to make highest RF channel power equal to -10 in the FSC
8. For all previously recorded RF channels, find the lowest power level.
9. Enable lowest power RF channel. Record FSC RMS power. This is the Target FSC Power.
10. Enabling all RF channels (individually), add FSC digital attenuation using the *transceptTenantCalTable.transceptTenantFscAttenX* fields in the Tenant OAM MIB until each RF channel is set to the Target FSC Power (+/- 0.5dB)

This completes the Hub Forward Balancing. Record HDC and FSC attenuator settings for future use.

### 3.1.3 RAN Setup

This section outlines the procedure for balancing the RAN forward output, where X is the RAN ID of the RAN being balanced:

1. Using the the *transceptTenantOAMTable.transceptTenantChannelXVal* field of the Tenant OAM MIB, enable the first BTS carrier (first Tenant channel)
2. Using the *transceptTenantPowerAdjustmentTable.transceptTenantRanYSifPower* field in the Tenant OAM MIB, copy the SIF power value into the *transceptTenantPowerAdjustmentTable.transceptTenantRanYSingleCarrierSetpoint* field of the Tenant OAM MIB for the first tenant RAN.
3. Using the *transceptTenantOAMTable.transceptTenantRanYDisable* field of the Tenant OAM MIB, enable the PA for the first RAN on desired Tenant Sector (there may be up to 8 RANs on a given Tenant Sector).
4. Using the *transceptTenantCalTable.transceptTenantRanYOutputPower* field of the Tenant OAM MIB, measure the PA output power.

5. Using the *transceptTenantGenTwoTable.transceptTenantRucYAttenOffset* field in the Tenant OAM MIB, adjust the RUC attenuator offset until the “per carrier” PA output is as shown in the Standard Digivance CXD-4XD-G1 Configuration Table shown above. (+/- 1.0 dB)
6. Repeat steps 2-5 for all RANs for this Tenant Sector.
7. Using the *transceptTenantOAMTable.transceptTenantChannelXVal* fields of the Tenant OAM MIB, enable all RF channels.
8. Using the *transceptTenantCalTable.transceptTenantRanYOutputPower* fields of the Tenant OAM MIB, examine the PA output power on all RANs. Ensure that with all carriers present that the power for each is correct. The total power is calculated by  $10 \cdot \log_{10}(\#carriers) + \text{single carrier power}$ . Using the *transceptTenantGenTwoTable.transceptTenantRucYAttenOffset* field in the Tenant OAM MIB, adjust the RUC attenuator to perform final adjustments with all carriers present.
9. With a single CW input at the BIM, measure the difference between the FSC RMS power (*transceptTenantFscPowerTable.transceptTenantFscIOutputPower*) and the RAN PA output power (*transceptTenantCalTable.transceptTenantRanYOutputPower*) in the Tenant OAM MIB. Record this value in the RAN Measured Gain entry (*transceptTenantOAMTable.transceptTenantRanXMeasuredForwardGain*) for that RAN. This is now the “ideal gain” for this tenant in this RAN.

The forward balancing is complete for this Tenant Sector. Record RUC attenuator values and PA Calibration Setpoint values (*transceptTenantPowerAdjustmentTable.transceptTenantRanYSingleCarrierSetpoint*) for future use.

## 3.2 Reverse Path Balancing

The reverse gain indicates how much gain the Digivance CXD will give to a reverse path signal before presenting it to the base station (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 4-4. Reverse Gain Settings**

REVERSE GAIN (DB)	COMMENT
+30	Bypass BTS reverse path gain included in duplexer (e.g. Nortel TDMA Base Stations)
+10	Normal setting, for dedicated BTS sector
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 Digivance CXD coverage

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

1. Measure or calculate cable loss from BIM Output to BTS input
2. Enter cable loss value (forward and reverse) into the transceptTenantForwardCableLoss and transceptTenantReverseCable Loss fields of the Tenant OAM MIB field for this Tenant Sector
3. Enter reverse gain setting (-10 to +10 dB, typically +10 dBm) into the transceptTenantReverseGain field of the Tenant OAM MIB for this Tenant Sector.

### **3.3 RGC Changes**

In a duplexed configuration, the RGC gain is set from +10dB to -10dB (see Figure 4-5?). In a non duplexed configuration (Figure 4-6?), the WSP would need the uplink set for 21 dB of gain with consideration give to:

- No 20 dB high power pad
- Cable loss from the BIM to BIP
- BIP losses.

The BIM to BIP losses must be measured by the installer and the result entered into the TENANT MIB.

### **3.4 FGC Changes**

FGC requires that the output power of the EBTS is known and the losses from the EBTS to the input to the BIM be measured and entered into the Tenant MIB.

### **3.5 Functional RAN Call Verification**

At the completion of BTS integration, that the coverage area is driven to insure all RANs are functional. Recommended In order to verify RAN calls the following procedure is followed

1. Place calls on all RF channels supported by targeted RAN sector
2. Ensure hand-offs between RANs and RAN to tower are functional.

## SECTION 5: BTS OPTIMIZATION

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### 1 NEIGHBOR LIST UPDATES

The Digivance CXD system has the ability to change the RF footprint of its donor base station on a sector by sector basis. Therefore, 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.

### 2 BTS PARAMETER CHANGES

The following section defines the required BTS parameter changes for operation with Digivance CXD.

#### 2.1 TDMA

Table 5-1 depicts BTS parameters that should be changed for operation with Digivance CXD. The final parameter settings will be determined by the WSP after optimizing the Digivance CXD BTS interaction and RF environment.

**Table 5-1. BTS Parameters**

<b>BTS MANUFACTURER</b>	<b>REQUIRED CHANGE</b>	<b>PARAMETER</b>	<b>PERFORMANCE PROBLEM</b>
<b>Ericsson</b>			
	Disable	DC Bias on BTS Rx Ports	BTS Bias Alarm
	Increase 10 dB	SSB Level (carrier sealing level)	Unable to place call on sealed carrier
	Increase 8 dB over BTS-only settings	SSI (Power Increase) level	Repeater/Tower handoff unbalanced
	Increase 8 dB over BTS-only settings	SSD (Power Decrease) level	Repeater/Tower handoff unbalanced
<b>Lucent</b>			
	Enable	Shortened Burst Mode	No calls initiated
	Change from 0 to 2.	Page 5 of FCI form, field 94	No calls initiated
	Set to 2. (Max delay setting)	If Page 5 is full, go to page 6 of FCI form, field 118	No calls initiated
	Disable	Hobbit	Intracell handoff occur
<b>Nortel</b>			
	Change from normal to ABBREV	DCCHDATA datafill FIELD 6	No calls initiated
	Disable	TLR (TDMA Locate Receiver)	No hand ins
	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

## 2.2 CDMA

There are four BTS parameters that are unique to the operation of a Digivance CXD sector. Along with these, the standard search window settings must be adjusted to compensate for the distributed antenna configuration. The first four BTS parameters are:

- Transmit propagation delay (add 100 usec to normal setting)
- Receive propagation delay (add 100 usec to normal setting)
- Maximum differential transmit delay
- Sector size

The *transmit propagation delay* compensates for the forward link delay from the channel element of the cell to the transmit antenna of the nearest RAN in the sector. This parameter determines the system ‘zero time’ for the sector from which all other delays in the forward direction are measured.



The *receive propagation delay* compensates for the reverse link delay from the receive antenna of the nearest RAN to the channel card of the cell. This parameter determines the ‘zero time’ for the sector from which all other reverse link delays are calculated.

The *maximum differential transmit delay* compensates for the delay differential from the nearest RAN to the furthest RAN within the sector. This parameter determines the search window sizes necessary to encompass the differential delay from each RAN in the sector

The *sector size* parameter compensates for the maximum air delay expected at any RAN in the sector. This parameter represents the maximum distance from any RAN at which the mobile will be able to access the system. A standard setting for this parameter is 2 miles.

## 2.3 IDEN

Update neighbor lists to allow hand-off between Digivance CXD and adjacent towers

PTO = 27 (RAN single channel output power)

### 2.3.1 Digivance CXD base station interface module setup

The interface between the EBTS and Digivance CXD allows for non-duplexed operation. The simplex block diagram for the BIM is shown in Figure 5-1.

Note: The first receive path of the IDEN EBTS needs to be connected to one of the Digivance CXD Hub outputs. If it is not, uplink SQE can be affected

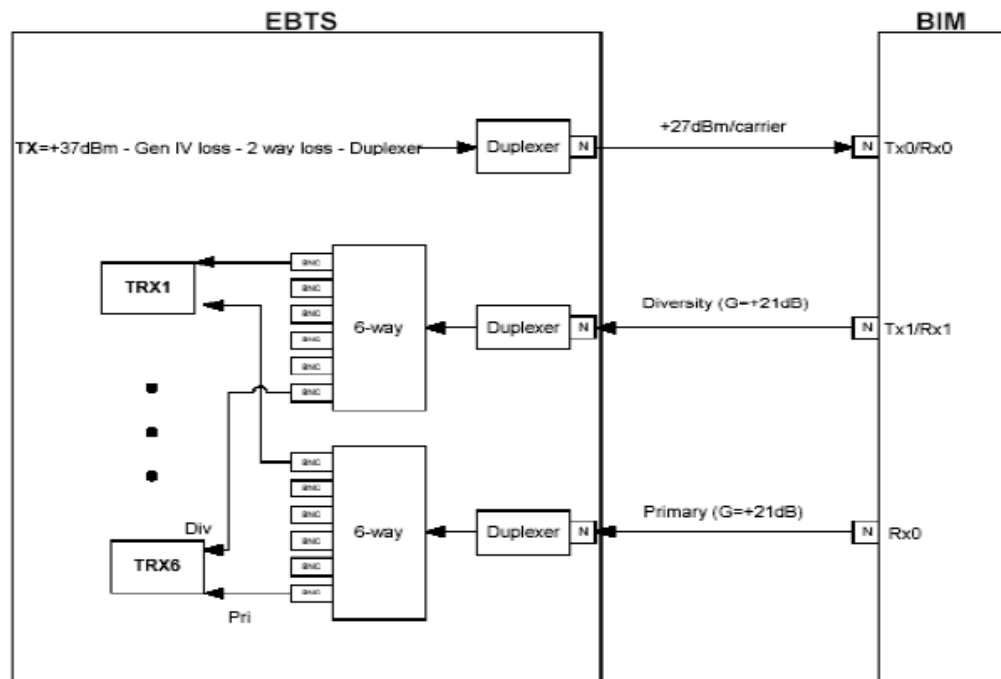


Figure 5-1. BIM Simplex Block Diagram

### 2.3.2 Receiver Multicoupler Setup

In the simplex configuration shown in Figure 5-2, the ETBS transmit feed is attenuated by a 30dB pad. The reverse paths are not attenuated and can provide as much as 40dB of gain. As shown in figure 5-2, each simplex receive path (primary and diversity) is connected to two external 6-way power dividers respectively. The 6-way power dividers will appropriately distribute uplink receive signals up to six separate primary and diversity receivers on the base radios.

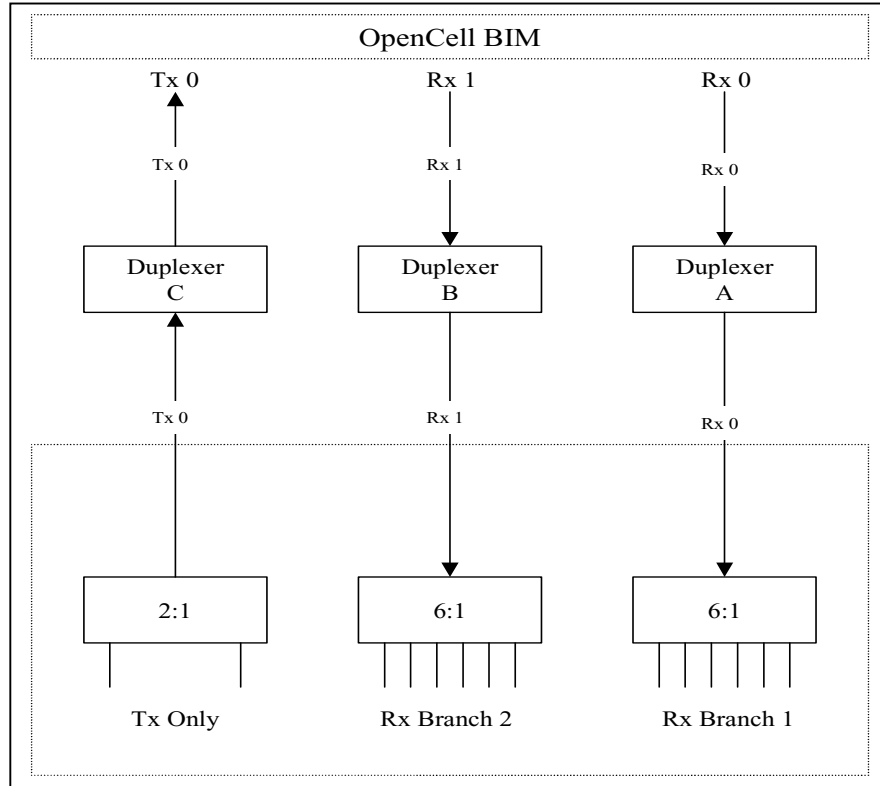


Figure 5-2. Receiver Multicoupler Setup

## SECTION 6: SOFTWARE UPDATES

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### 1 SOFTWARE RELEASE DELIVERABLE

The Digivance CXD software upgrade process is based on packaging utilities built into the Linux-based operating system used by Digivance CXD. The software upgrade is a set of interdependent packages delivered in a self-extracting executable named so as to reflect the revision of the contained software; for example: *hr-2.1.0-upgrade* would be used to upgrade a target Hub or RAN CPU to version 2.1.0. When invoked, the upgrade executable will automatically take the appropriate actions to upgrade the target CPU.

### 2 RELEASE NOTES

The release notes delivered with each software release distribution will contain specific details about the changes being made in that software release. The release notes will itemize each change made, including a description of the problem/issue being addressed, a description of how the problem/issue was resolved, and the impact of the change on the NMS.

Included in the release notes are details of any upgrades to the FPGA images, including revision number information contained in the latest release build. To ensure the latest documentation matches the current packaged images, the release notes will be the only place where this information is captured in external/customer documentation.

### 3 UPGRADING EXISTING SYSTEM

The most common upgrade scenario is one where an existing, fielded, operational system is having all of its CPU's upgraded to the next version of software. Some important notes regarding this type of upgrade:

### 3.1 Preliminary Steps

The following are some general notes that need to be considered when upgrading a fielded system:

- The Hub Master should be the final CPU upgraded in the network to ensure that any new network-level functions are managed and supported properly.
- It is assumed that a network administrator will be performing the upgrade.
- Upgrading an operational system will interrupt service, so upgrades should be planned during the maintenance window.
- An upgrade of a test CPU should be attempted prior to upgrading an entire system or set of systems.
- For upgrade verification purposes, note the PA power, RUC attenuator values, and module pathtrace values (see the transeptOpencellPathtraceTable MIB) on a test RAN CPU and follow instructions found in the section in this document labeled "Verification".
- The upgrade executable should be FTP'd to all target machines prior to upgrading any machine. This is more efficient than updating one machine at a time.
- The RAN CPUs should be upgraded first, as upgrading the HUB CPUs may interrupt telnet sessions to the RAN, thereby stopping the RAN upgrades.

### 3.2 Upgrade Steps

The following are the steps for installing and running the upgrade executable:

- FTP to the target CPU by entering: *ftp <ip/hostname>*, with "operator" as the username and "operate" as the password.
- Configure FTP to transfer in binary mode by entering: *bin*
- Explicitly set the target location by entering: *cd /var/*
- Push the distribution executable file to the target CPU by entering: *put <filename>*, where <filename> is something like "hr-2.0.0-upgrade".
- Exit out of the FTP session using *quit* or *exit*, depending on the FTP application being used.
- Telnet into the target CPU by entering: *telnet <ip/hostname>*, with "operator" as the username and "operate" as the password.
- Change to the directory where the upgrade is located by entering: *cd /var/*
- Change the upgrade file mode to be executable by entering: *chmod 555 <filename>*, where "filename" is something like "hr-2.0.0-upgrade"
- Run the upgrade distribution executable file by entering: *./<filename>*, where <filename> is something like "hr-2.0.0-upgrade".
- Upon completion of the upgrade, which will take several minutes, reboot the machine to be sure that everything starts normally by entering: *sudo reboot*

### 3.3 Verification

It is important to be sure that the upgrade was successful before continuing on with upgrading other CPUs in the network. Some of this verification is done automatically by the upgrade executable, but there are certain steps that need to be done manually as well.

Actions that are automatically taken by the upgrade executable to verify success include the following:

- Built in package management checks to be sure that files are being written and removed as expected.
- Checks to be sure that upon completion of the upgrade, certain processes are running (or no longer running, as the case may be) as expected.
- Test scripts being run to ensure that processes are running as expected.

If the autonomous actions taken by the upgrade executable discover that the upgrade was not successful, the upgrade executable will report this information in the log file located at */var/log/opencell-upgrade*. Otherwise, a successful status message will be reported to that log.

Manual steps must also be taken to ensure that the upgrade process completed successfully. Note that some of the manual validation steps below may also be performed by the automatic validation described above.

The process list should be examined to be sure that the appropriate processes are running. This can be done by telnetting into the target CPU (see "Upgrade Steps" section above) and entering:

*ps ax | grep "/usr/bin/"*. The list that is returned will indicate all processes that were run from the system binary directory. This list should include the following, at a minimum:

/usr/bin/pathtrace	/usr/bin/rgc
/usr/bin/nodepaths	/usr/bin/equipment
/usr/bin/netnode	/usr/bin/stf
/usr/bin/hlpwatch	/usr/bin/i2cbusscan
/usr/bin/pcibusscan	/usr/bin/i2busmaster (6 instances)
/usr/bin/fgc	/usr/bin/gps
/usr/bin/niprs (4 instances)	/usr/bin/ <i>hcp</i>

Where *hcp* represents the listing of all HCPs that correspond to the modules being controlled by the target CPU. These are specific to the target CPU being upgraded and include HDC, BIM, FSC, HUC, MUC, RUC, RDC, SIF, and RSC. There should be one instance of each HCP per module managed by the target CPU.

When evaluating the process list, it is important to be sure that the process IDs of each of the listed processes above stay stable to ensure that processes are not continually restarting. Run the command *ps ax | grep /usr/bin/* multiple times over the course of a minute or two to be sure that this is the case.

In addition to the above processes, it must be verified that the SNMP agent software is running. This is done by entering: *ps as | grep "/usr/local/sbin"* and verifying that */usr/local/sbin/snmpd* is one of the processes listed.

Evaluate the software version to be sure that it matches what is intended. This can be done from the NMS by evaluating the Network Node MIB field

*transceptNetworkNodeOpencellSoftwareRev*. Alternatively, this value can be retrieved in the telnet session to the CPU opened in the previous step by entering:

*snmpget localhost patriots transceptNetworkNodeOpencellSoftwareRev.0*

On the upgraded CPU, verify pathtrace values are as expected by viewing the *transceptOpencellPathtraceTable* MIB. Refer to the above "Preliminary Steps" section for details.

On the upgraded RAN CPU, verify PAs are functioning and power levels are as expected. Refer to the above "Preliminary Steps" section for details.

### 3.4 Failed Upgrades

In the case of a failed upgrade, it will be desirable to attempt to return the target CPU to its previous revision by uninstalling the most recent software upgrade. This action will be accomplished with the use of a downgrade script that is installed as part of the upgrade. The name of the downgrade script will contain the name of the version being downgraded to; for example, *hr-2.0.0-downgrade* would be used to revert a CPU that has been upgraded to version 2.1.0 back to 2.0.0.

It is important that, upon completion of a downgrade, the verification steps described in the previous section are taken to ensure that the CPU is left in an operational state.

### 3.5 FPGA Updates

Certain software releases will contain updates to the FPGA images that the Digivance CXD modules load on startup. These FPGA image updates need to be programmed into an EEPROM on the module(s) in question. This is an operator initiated event which is described in detail below. Depending on the module(s) being updated with new FPGA images, this action could take as long as 20-30 minutes to complete



**Note:** When the FGPA's download is completed, service will be briefly interrupted during board reset.

The HCP's (FSC, HUC, RDC, and RUC) will automatically evaluate the hardware module revision and determine if the FPGA image in the FPGA Prom is outdated. If this is the case, the HCP will generate a "mismatched Revision" fault. This indicates to the operator that the FPGA's must be updated by following the manual restart process outlined below. The HCP's will use the transcript *HcpLoadFpgaProm* fields in the HCP MIB's to report the status of the Prom loading. The enumerated values in this MIB field are:

- noStatus(0) : Indicates that no Prom Load has been attempted
- loadingProm(1) : Indicates that a Prom Load is in progress / manually start a Prom Load.
- loadSuccess(2) : Indicates that a Prom Load has completed successfully.
- loadFailure(3) : Indicates that a Prom Load attempt has failed.

The transcript *HcpLoadFpgaProm* fields in the HUC, RDC, RUC, and FSC MIB's need to be monitored (via SNMP polling or traps) in order to detect failed FPGA Prom Loads (value = loadFailure(3), which is a fault condition that needs to be remedied by manually restarting the Prom Load session. This manual restart is accomplished by changing this MIB field to a value of loadingProm(1). In addition to polling for loadFailure(3), the NMS should also poll for a value of loadSuccess(2) in order to log the fact that a successful Prom Load has taken place, and for a value of loadingProm(1) to know that a Prom Load is underway. Please refer to the Fault and Troubleshooting guide for details.

## 3.6 Backup/Restore

There are several files on a CPU being upgraded that should be backed up in case something goes wrong with the upgrade and need to be restored. This set of files includes the MIBmap files where MIB data is stored, as well as several system configuration files.

The upgrade executable will automatically run the backup script to take care of backing up all key files. These files will be bundled into a file that will be stored on the CPU being upgraded, in the /var directory. This file will be given a name that associates it with version of the upgrade being performed, for example: *backup-pre-2.1.0.tar.gz*.

Upgrading a CPU does not require that a restore of the backed up files be performed unless a problem is encountered. Any data contained in the MIBmap files and any configuration data in the system configuration files will remain untouched through a software upgrade. The only time that backup data needs to be recovered is when an upgrade has failed and the CPU is being reverted to the previous version using the downgrade script. In this event, the downgrade script will automatically attempt to restore the backup data at the end of the downgrade process.

Alternatively, the backup/restore steps can be run manually, with the backup file being saved to any location on any CPU connected to the network. The steps for doing this are as follows:

### 3.6.1 Backup:

Telnet to the target CPU, using operator/operate as the username/password.

Run the backup script:

```
sudo backup-hubmaster operator@<target-IP>:/var <backupname>.tar
```

### 3.6.2 Restore:

Again, note that a restore only needs to be performed if problems with the upgrade have been encountered and the CPU is going to be downgraded.

Telnet to the target CPU, using operator/operate as the username/password.

Run the restore script:

```
sudo backup-hubmaster -r operator@<target-IP>:/var <backupname>.tar
```

Reboot by entering: *sudo reboot*

Note that the restore script is simply the backup script invoked with a "-r" switch. The "-r" switch is identical to the switch "--restore".

## 4 UPDATING SPARE CPU'S

There are times when it is desirable to update the software on a spare CPU. The general approach for updating a spare CPU is to install the CPU into an available chassis that is connected to the network and execute the upgrade steps detailed in the previous section above. The software upgrade process associated with upgrading a spare CPU is exactly as described in the "Upgrading Existing System" section above. The only difference between upgrading a spare CPU and an existing system is that a physical location for upgrading the spare CPU must be determined.

There are a few ways to make a CPU chassis slot available:

Unplug a CPU that resides in the existing fielded system and replace it (temporarily) with the spare CPU. When finished upgrading the spare CPU, return the original CPU to that slot in the chassis.

Dedicate a chassis to be used strictly for this type of update and for verification and test. This is the recommended option for CPU's not slated for immediate installation.

There are limitations with this type of update that need to be observed:

- It is important that all Hub/RAN CPU's that reside on the same network are able to communicate with their Hub Master. Therefore, if the spare CPU is too far outdated, this may not be possible. In order to avoid a conflict, it is only possible to update a spare CPU on the fielded system network if the current major version of the spare CPU is the same as that of the CPUs in the fielded system. For example, if all the CPUs in the fielded system are currently at revision 2.2.0 and the spare CPU is at 2.0.0, it is possible to update that CPU with the method described above. However, if the spare CPU in this example is at 1.7.0, it is not possible. This implies that if an Digivance CXD software release is of a new major revision, spare CPU's in stock need to be upgraded at the same time as all of the other CPU's in the fielded system.



- In the event that a spare CPU cannot be updated because of the above restriction, the CPU will have to be upgraded on a standalone chassis that is not resident on the fielded system or be returned to the factory for upgrading.
- It is NOT possible to update a spare Hub Master CPU while the fielded system's Hub Master is still installed, because two Hub Masters in the same domain will cause IP and DHCP interference on the network. The only way to update the software on a spare Hub Master CPU in a fielded system is to unplug the Ethernet cable from the original Hub Master CPU and plug that cable into the spare Hub Master CPU. When the upgrade of the spare Hub Master CPU is complete, the Ethernet cable can be plugged back into the original Hub Master CPU.



**Note:** It is highly recommended that spare CPU's not slated for immediate installation are upgraded in a dedicated chassis in a depot or warehouse environment.

## 5 MIB EXTRACTION

The following procedure outlines the process for extracting the MIB's needed to update the NMS after a software update:

- Once the software upgrade is complete, FTP to one of the updated CPUs, logging in as username = operator and password = operate.
- Change to the MIB directory by entering: `cd /usr/share/mibs/transcept/`
- Extract/get all of the MIB text files located there by entering: `mget TRANSCEPT*.txt`, answering yes to each prompt.
- Extracting the MIB's in this fashion will ensure that the correct and compatible versions of all of MIB's are compiled into the NMS.

Alternatively, the MIB's can all be extracted in the form of a tarball by executing the following steps:

- FTP to one of the updated CPUs, logging in as username = operator and password = operate.
- Change to the directory containing the Digivance CXD MIB's directory by entering: `cd /usr/share/mibs/`

Bundle and zip all the MIB's into a tarball and extract them by entering: `get transcept.tar.gz`.

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## SECTION 7: AUTONOMOUS SOFTWARE FUNCTIONALITY

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### 1 INTRODUCTION

This chapter outlines the concepts and performance objectives involved in the gain management and fault detection (continuity) of the Digivance CXD system. This section breaks these topics down into five areas:

- Forward gain management
- Reverse gain management
- Forward delay management
- Reverse delay management
- Forward continuity
- Reverse continuity.
- PA Overpower Protection
- Hub Overpower Protection

### 2 FORWARD GAIN MANAGEMENT

The Digivance CXD system has a static forward gain of 42 dB is its default Composite Mode. This gain can be changed by methods described in the tenant configuration section of this document.

### 3 REVERSE GAIN MANAGEMENT

The Digivance CXD system autolimits any strong in-band signal which reaches the RAN at a peak input level of -40 dBm relative to the antenna port. The process does this by continuously monitoring digital input at the FPGA adding attenuation at the RDC if the threshold is reached. This “AGC event” is logged on the CPU running the RDC process. Attenuation is backed out as the signal strength subsides.

In all other cases, Reverse Gain Management is a static process in the Digivance CXD software where the reverse path gain is balanced to match the Reverse Gain parameter set in the Tenant OAM MIB (see Tenant Configuration section of this document). This balancing is accomplished solely by Tenant Processing by using the constant gain factors of the reverse path modules to adjust the BIM attenuators such that the Reverse Gain (minus the Reverse Cable Loss) is achieved.

### 4 FORWARD DELAY MANAGEMENT

Forward Delay Management (FDM) is a software function that is part of Tenant Processing and whose responsibility is to equalize the forward path delays to all RAN's in a simulcast group. The FDM process is run each time a RAN is added or removed from the simulcast group, if the FDM process is "enabled" in the Tenant OAM MIB (see Tenant Configuration section of this document). The FDM process algorithm is as follows:

Start with Forward Base Delay Target configured in the Tenant OAM MIB (See Tenant Configuration section of this document).

Set the delay value in the RAN SIF's to make them equal to the base delay plus some delay skew based on the RAN ID.

The amount of delay skew is based on the Forward Delay Skew configured in the Tenant OAM MIB (See Tenant Configuration section of this document) and the RAN ID using the following:

Total Delay = Base delay + (delay skew X(RAN ID -1)).

### 5 REVERSE DELAY MANAGEMENT

Reverse Delay Management (RDM) is a software function that is part of Tenant Processing and whose responsibility is to equalize the reverse path delays from all RAN's in a simulcast group. The RDM process is run each time a RAN is added or removed from the simulcast group, if the RDM process is "enabled" in the Tenant OAM MIB (see Tenant Configuration section of this document). The RDM process algorithm is as follows:

Start with Reverse Base Delay Target configured in the Tenant OAM MIB (See Tenant Configuration section of this document).

Set the delay value in the Hub SIF's to make them equal to the base delay plus some delay skew based on the RAN ID.

The amount of delay skew is based on the Reverse Delay Skew configured in the Tenant OAM MIB (See Tenant Configuration section of this document) and the RAN ID using the following:

Total Delay = Base delay + (delay skew X(RAN ID -1)).

## 6 FORWARD CONTINUITY

Forward Continuity Management (FCM) is a software function that works in conjunction with Forward Gain Processing (FGC) and is responsible for ensuring that the forward RF paths are functioning properly and are able to pass signals.

The FCM process runs continuously on a periodic basis (once per minute) and reports any path failures as faults in the FGC MIB. If fault conditions are no longer present, then the fault indication will be cleared. Typical events that will clear a fault include:

- Replacement of failed module
- Power failure, followed by power restore
- Autonomous action (E.g. PLL out of lock, re-tune, module okay)
- Intermittent failure.
- Disabling BIM test tones in the case where the BIM is bypassed in the forward path

The following descriptions outlines the logical process by which system level faults are detected and isolated, where possible, to a particular module:

### 6.1 HUB

The FCM process will check to verify BIM test tones are enabled, and if so notify the BIM to inject test tones on one of the 8 tenant-sector channels. The FSC power for the corresponding channel will be read and checked to be sure that it is no less than 3 dB below the target value for the BIM Tone. If the signal level is 3 dB below the BIM tone level, a fault will be flagged for that channel. Once all channels are checked then the module isolation is performed to determine which piece of hardware is likely failing:

In the case of a single HDC card:

- If all channels fault, then the BIM module is declared to be at fault.
- If not all channels fault, then either the HDC or FSC module is declared to be at fault.

In the case of a dual HDC card:

- If all channels fault, then the BIM module is declared to be at fault.

- If the channel faults are confined to channels 1-4, then either the HDC #1 or the FSC module is declared to be at fault.
- If channel faults are confined to channels 5-8, then either the HDC #2 or the FSC module is declared to be at fault.

## 6.2 RAN

As the forward RF detectors in the RAN are geared for accuracy at high-power outputs, they are not suited for the power levels required for FGC non-destructive tests. However, the digital detectors are monitored. The fault detection process in the RAN will generate a fault if the gain drops by 10 dB or if pathtrace is lost at the digital path. This check is performed as part of FGC during the normal course of gain management. See trouble shooting guide for details.

## 7 REVERSE CONTINUITY

Reverse Continuity Management (RCM) is a software function that is a subset of Tenant Processing and is responsible for ensuring that the reverse RF paths for each tenant-sector are functioning properly and are able to pass signals.

The RCM process runs continuously on a periodic basis (once per minute) and reports any path failures as faults in the RGC MIB. If fault conditions are no longer present, then the fault indication will be cleared. Typical events that will clear a fault include:

- Replacement of failed module
- Power failure, followed by power restore
- Autonomous action (E.g. PLL out of lock, re-tune, module okay)
- Intermittent failure.
- Disabling the RDC test tones

The following descriptions outline the logical process by which system level faults are detected and isolated, where possible, to a particular module. Noise and an RF tone are monitored in the reverse direction, in order to confirm an operational reverse path. Noise is detected using a Power Measurement in the HUB SIF module. The tone is detected using an FFT in the HUB SIF and the BIM RF Output detector. If measured values fall below specified threshold values, then faults will be generated.

### 7.1 Noise

The front-end noise will be monitored by reading the noise power value from the reverse channels in the RAN SIF module belonging to the tenant-sector being analyzed. The in-band noise power (N) and total signal power (S+N) will be measured and analyzed in the SIF using an FFT analysis, as follows:

- Integrated power for 24.6 to 39.6 MHz (dBm) using lowest 33% of the bins (Noise Power)
- Integrated power for 24.6 to 39.6 MHz (dBm) using lowest 100% of the bins (Signal Plus Noise Power)

The RCM software will generate faults if the integrated power levels are below the specified thresholds.

## 7.2 RDC Tone

The RDC Tone will be enabled at all times, unless explicitly disabled via the RDC MIB. Its frequency corresponds to the first channel in the band set for that tenant-sector. Additional requirements are:

- The RDC tone level is  $-80$  dBm referenced to the front end antenna port of the RAN
- The RDC Tone is available on the primary and diversity paths

In the RAN, power measurements are taken at the reverse channels of the RAN SIF belonging to each tenant-sector. In the Hub, these power measurements are taken at the BIM. These power measurements are performed continuously on a one-minute poll rate and are compared to specified threshold values.

- If the test tone is not detected in the RAN SIF, then the RDC is reported as faulting. See troubleshooting guide for details.

## 7.3 HUC Tone

The HUC tone will be enabled at all times, unless explicitly disabled via the HUC MIB. Its frequency corresponds to the last channel in the band set for that tenant-sector. Additional requirements are:

- The HUC tone level is  $-60$  dBm relative to the antenna port at the RAN.
- If the test tone is not detected at the BIM, it and the HUC are reported as faulting.
- See troubleshooting guide for details.

## 8 PA OVERPOWER PROTECTION

PA Overpower Protection (POP) is a software function that prevents damage to the PA as well as preventing the PA from exceeding FCC spurious output limits.

POP measures the PA Output Power once per second from the RUC/PA MIB. If the PA Output Power exceeds a determined threshold, then POP will deactivate the FGC process for the tenant-sector in question, add attenuation to the RUC, and set a fault in the FGC MIB. Once the PA Output Power returns to a value that is less than a determined threshold, then the POP fault will be cleared and normal operation will resume. See troubleshooting guide for details.

## 9 HUB OVERPOWER PROTECTION

Hub Overpower Protection (HOP) is a software function to control the output levels of the FSC. HOP periodically measures the FSC output power. If the power exceeds a target level, HOP will decrease the FSC output gain until the power level is below the allowable threshold. HOP will continue to monitor the FSC Output Power until the level drops sufficiently to allow the gain level to be returned to normal.

If HOP is required to take autonomous action on any of the FSC inputs or the FSC output, a HOP Status field in the FSC MIB will be set such that the NMS report the condition and an operator can take corrective action. This MIB entry can be found as follows:

*transceptFscHopTable.transceptFscHopModeRms*

Status values include *hopActive* and *hopInactive*. See troubleshooting guide for details.



## SECTION 8: MIB STRUCTURE

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### 1 MIB RELATIONSHIPS

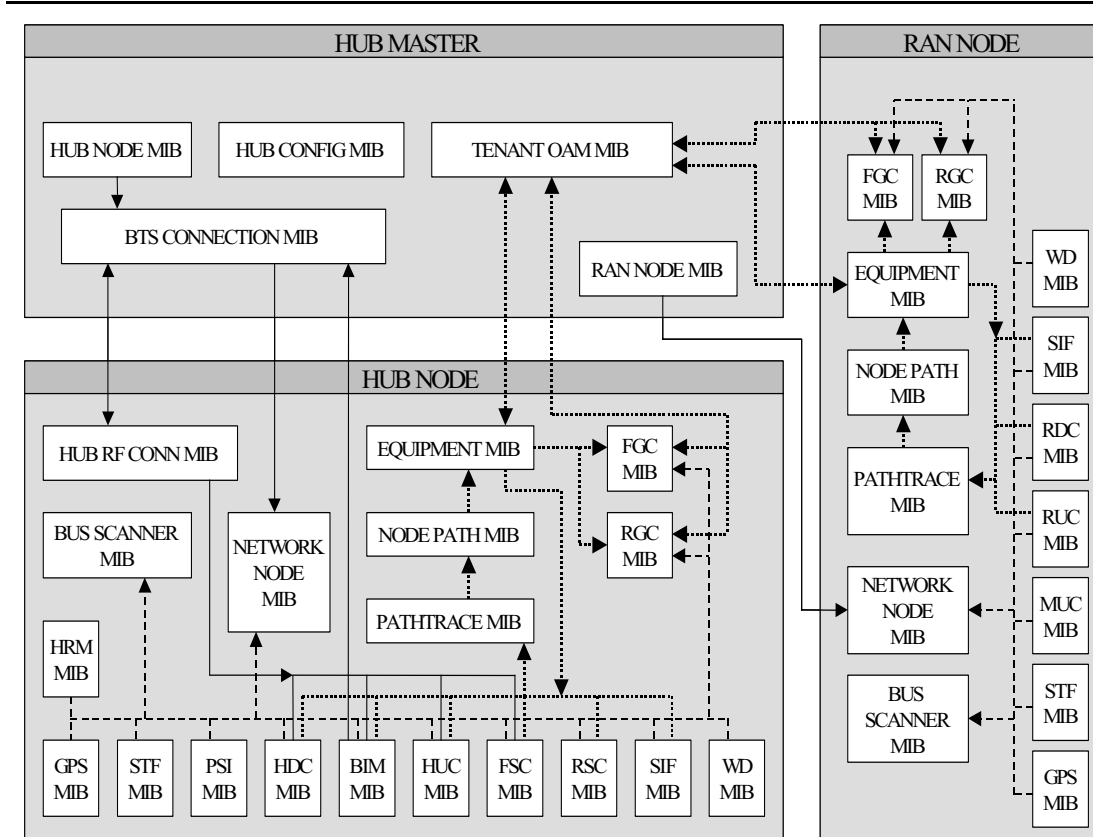
MIB is an acronym for Management Information Base, and defines a set of managed objects used in the SNMP protocol. MIB's define the supported interface into an SNMP device. The managed objects defined in the Digivance CXD MIB's provide the monitoring and control capability into the Digivance CXD system.

SNMP Management applications, such as the customer Network Management System, use the definitions provided in MIB's to monitor and control SNMP devices, such as the CPUs in the Digivance CXD network. SNMP Management applications may or may not allow direct access to MIB's through a MIB Browser, so it is important to refer to the User's Manual for the SNMP Management application being used. Digivance CXD MIB's are provided as part of the software package delivered to Digivance CXD customers so that the customer can compile the Digivance CXD MIB's into the NMS and monitor/control the Digivance CXD equipment.

Figure 8-1 displays the MIB's used in the Digivance CXD system, which node\* type(s) each MIB is used in, and how the MIB's are related to each other. The sections that follow will describe each of the MIB's and how they are used in the Digivance CXD system.

(\*) Within the Digivance CXD network, there are four node types: Hub Node, RAN Node, LSE node, and Hub Master Node, where "node" is simply shorthand for "network node". In the Digivance CXD system, node simply refers to the CPUs used in the Digivance CXD network. It is also important to note that the Hub Master node is a regular Hub node with additional functionality that is particular to the one and only Hub Master node in the network. The LSE node is also a regular Hub node with additional functionality particular to location services applications.

## MIB RELATIONSHIPS



**Figure 8-1. MIB Relationships**

MIB's described in Figure 8-1 and in the sections below provide a general overview of the MIB's used in the Digivance CXD system. MIB's may be added, deleted or changed as the product is developed and as enhancements are added.

Changes to MIB's are made in such a way as to make them backward compatible with existing SNMP Managers. This is accomplished by only allowing new MIB objects to be added to the end of MIB's instead of deleting or changing existing MIB objects. MIB objects that are no longer required will simply exist in the MIB's, but will no longer be accessed.

## 2 HARDWARE RELATIONSHIPS

In Figure 8-1, the dashed lines seen in the Hub and RAN Nodes show the relationships among MIB's associated with specific hardware modules.

A separate software HCP (hardware control process) is used to manage each hardware module in a node, where HCP MIB's are the interface to these HCP's. A single MIB instance is used in each node for each type of hardware (HDC, RDC, etc.).

Each Hub/RAN node contains a Bus Scanner process whose responsibility is to discover the presence/absence of hardware modules and to start/stop HCP's to manage those hardware modules. The Bus Scanner MIB reports the information defining the hardware "discovered" at that node.

Each node contains a Network Node process to manage information about that CPU, where the interface is the Network Node MIB. This MIB contains information about the CPU itself (e.g. IP Address, Hostname, etc.), Hub/RAN specific information (Pole ID, RAN Box ID, etc.), and other miscellaneous status information. In addition, this MIB reports a high-level fault status for each HCP type. If any HCP in that node reports a fault of any type in its HCP MIB, the Network Node MIB fault field corresponding to that HCP will report a problem.

## 2.1 Hub/RAN Connection Relationships:

In Figure 8-1, the solid lines between the Hub Master and Hub/RAN nodes illustrate Hub/RAN connection relationships.

The Hub Master contains a process called the Hub/RAN Config Process that is responsible for managing the connections between the Hub Master and the other nodes in the network. This process uses the Hub Node MIB and RAN Node MIB to manage these connections. The Hub/RAN Node MIB's allow specific information about the Hub/RAN nodes to be configured. This includes such things as Site ID, Pole ID, and RAN hardware connections. The Hub/RAN Config Process will push the information configured in these MIB's down to the Network Node MIB at each node. Refer to the section of this document that covers "Network Setup" and "Configuring Nodes" for a more in-depth explanation of how to use these MIB's.

The Hub/RAN Config Process is also responsible for preparing the Hub Master to have tenant relationships established. This process uses the information set in the Hub Node MIB and BTS Connection MIB to configure the tenant relationships. Information that is provided in the BTS Connection MIB as part of Tenant Setup will be pushed down to the Hub RF Connection MIB in the Hub Nodes. Refer to the section of this document that covers "Configuring the Digivance CXD System for Operation" for a more in-depth explanation of how these MIB's are used.

## 2.2 Tenant Relationships:

In Figure 8-1, the dotted lines among Hub Master and Hub/RAN nodes illustrate tenant relationships.

Once a tenant is created using the BTS Connection of the previous section, then a Tenant process is kicked off to manage that new tenant. This tenant process uses the Tenant OAM MIB in the Hub Master node to allow tenant specific parameters to be configured. These parameters allow the setting of frequency, gain, and delay values as well as any other tenant specific information. When these values are set, the Tenant process pushes this information to the Equipment MIB at the appropriate node(s).

In addition, the Tenant process uses the Tenant OAM MIB to report any status information about the tenant, such as hardware faults and RAN location information, which is gathered from the Equipment MIB's at the Hub/RAN nodes.

Tenant processing determines the location of its related nodes and hardware using a process called the Tenant Scan process that polls the Equipment MIB's located at each node in the network. If the Equipment MIB indicates that there is hardware belonging to that tenant on that node, then the Tenant process in the Hub Master will add that node to its "managed node" list. The Tenant process will then use the Equipment MIB's on its managed nodes to interface to the hardware equipment belonging to it.

The Tenant Equipment process on each Hub/RAN node will process all Equipment MIB requests and will report all tenant equipment status in the Equipment MIB.

In the Hub/RAN nodes, the Node Paths process is responsible for detecting tenant equipment using the results of the Pathtrace MIB and reporting this information in the Node Path MIB. In effect, the information of the Node Path MIB is just a reorganization of the Pathtrace MIB information to simplify the Tenant Equipment process. The Tenant Equipment process uses the information in the Node Paths MIB to identify equipment belonging to specific tenants.

The information reported in the Pathtrace MIB is generated by the Pathtrace process on each Hub/RAN node. The Pathtrace process examines the pathtrace fields of each HCP MIB and reports them in a single MIB containing only information related to pathtrace, such as the HCP type and location, as well as the pathtrace string value itself.

Tenant processes in the Hub Master push down gain control information from the Tenant OAM MIB to the Forward/Reverse Gain MIB's located in the Hub/RAN nodes. Forward/Reverse Gain processes use the values set in the Forward/Reverse Gain MIB's as target values when managing the gain in those nodes.

The Forward/Reverse Gain processes in the Hub/RAN nodes use the Equipment MIB to determine the location of the hardware belonging to the tenant whose gain is being managed. The Forward/Reverse Gain processes then access the HCP MIB's to read power values and set attenuator values as part of gain control. The results of the gain control processes are then reported into the Forward/Reverse Gain MIB's.

## SECTION 9: GENERAL INFORMATION

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### 1 WARRANTY/SOFTWARE

The Product and Software warranty policy and warranty period for all ADC products is published in ADC's Warranty/Software Handbook. Contact the Technical Assistance Center at 1-800-366-3891, extension 73476 (in U.S.A. or Canada) or 952-917-3476 (outside U.S.A. and Canada) for warranty or software information or for a copy of the Warranty/Software Handbook.

### 2 SOFTWARE SERVICE AGREEMENT

ADC software service agreements for some ADC Products are available at a nominal fee. Contact the Technical Assistance Center at 1-800-366-3891, extension 73476 (in U.S.A. or Canada) or 952-917-3476 (outside U.S.A. and Canada) for software service agreement information.

### 3 REPAIR/EXCHANGE POLICY

All repairs of ADC Products must be done by ADC or an authorized representative. Any attempt to repair or modify ADC Products without authorization from ADC voids the warranty.

If a malfunction cannot be resolved by the normal troubleshooting procedures, Technical Assistance Center at 1-800-366-3891, extension 73476 (in U.S.A. or Canada) or 952-917-3476 (outside U.S.A. and Canada). A telephone consultation can sometimes resolve a problem without the need to repair or replace the ADC Product.

If, during a telephone consultation, ADC determines the ADC Product needs repair, ADC will authorize the return of the affected Product for repair and provide a Return Material Authorization number and complete shipping instructions. If time is critical, ADC can arrange to ship the replacement Product immediately. In all cases, the defective Product must be carefully packed and returned to ADC.

## **4 REPAIR CHARGES**

If the defect and the necessary repairs are covered by the warranty, and the applicable warranty period has not expired, the Buyer's only payment obligation is to pay the shipping cost to return the defective Product. ADC will repair or replace the Product at no charge and pay the return shipping charges.

Otherwise, ADC will charge a percentage of the current Customer Product price for the repair or NTF (No Trouble Found). If an advance replacement is requested, the full price of a new unit will be charged initially. Upon receipt of the defective Product, ADC will credit Buyer with 20 percent of full price charged for any Product to be Out-of-Warranty. Products must be returned within (30) days to be eligible for any advance replacement credit. If repairs necessitate a visit by an ADC representative, ADC will charge the current price of a field visit plus round trip transportation charges from Minneapolis to the Buyer's site.

## **5 REPLACEMENT/SPARE PRODUCTS**

Replacement parts, including, but not limited to, button caps and lenses, lamps, fuses, and patch cords, are available from ADC on a special order basis. Contact the Technical Assistance Center at 1-800-366-3891, extension 73476 (in U.S.A. or Canada) or 952-917-3476 (outside U.S.A. and Canada) for additional information.

Spare Products and accessories can be purchased from ADC. Contact Sales Administration at 1-800-366-3891, extension 73000 (in U.S.A. or Canada) or 1-952-9938-8080 (outside U.S.A. and Canada) for a price quote and to place your order.

## **6 RETURNED MATERIAL**

Contact the ADC Product Return Department at 1-800-366-3891, extension 73748 (in U.S.A. or Canada) or 952-917-3748 (outside U.S.A. and Canada) to obtain a Return Material Authorization number prior to returning an ADC Product.

All returned Products must have a Return Material Authorization (RMA) number clearly marked on the outside of the package. The Return Material Authorization number is valid for 90 days from authorization.

## 7 CUSTOMER INFORMATION AND ASSISTANCE

### PHONE:

#### EUROPE

Sales Administration: +32-2-712-65 00

Technical Assistance: +32-2-712-65 42

#### EUROPEAN TOLL FREE NUMBERS

Germany: 0180 2232923

UK: 0800 960236

Spain: 900 983291

France: 0800 914032

Italy: 0800 782374

#### U.S.A. OR CANADA

Sales: 1-800-366-3891 Extension 73000

Technical Assistance: 1-800-366-3891

└ Connectivity Extension 73475

└ Wireless Extension 73476

#### ASIA/PACIFIC

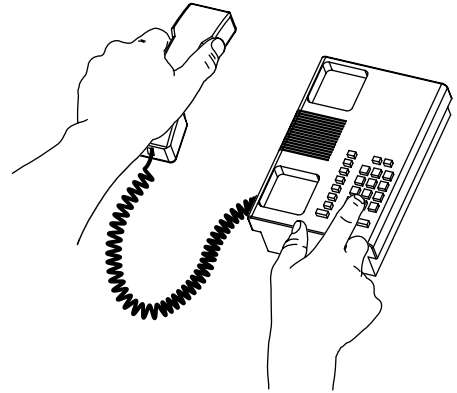
Sales Administration: +65-6294-9948

Technical Assistance: +65-6393-0739

#### ELSEWHERE

Sales Administration: +1-952-938-8080

Technical Assistance: +1-952-917-3475

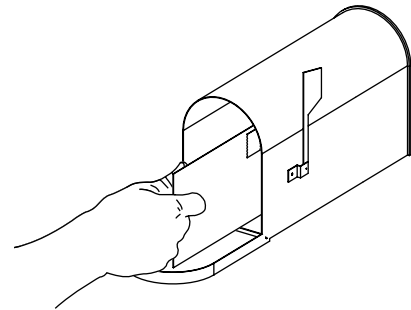


### WRITE:

ADC TELECOMMUNICATIONS, INC  
PO BOX 1101,  
MINNEAPOLIS, MN 55440-1101, USA

ADC TELECOMMUNICATIONS (S'PORE) PTE. LTD.  
100 BEACH ROAD, #18-01, SHAW TOWERS.  
SINGAPORE 189702.

ADC EUROPEAN CUSTOMER SERVICE, INC  
BELGICASTRAAT 2,  
1930 ZAVENTEM, BELGIUM



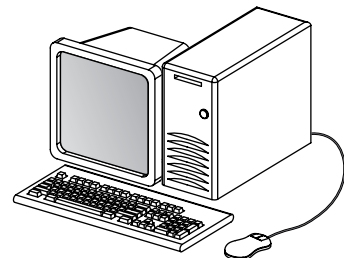
### PRODUCT INFORMATION AND TECHNICAL ASSISTANCE:

[connectivity.tac@adc.com](mailto:connectivity.tac@adc.com)

[wireless.tac@adc.com](mailto:wireless.tac@adc.com)

[euro.tac@adc.com](mailto:euro.tac@adc.com)

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