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# **Digivance<sup>®</sup> CXD/NXD Multi-Band Distributed Antenna System With FIC Operation Manual**

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## REVISION HISTORY

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2	04/2007	Updated for new card configuration (Fiber Interface Controller replaces Synchronous Interface Card). Expanded to include NXD descriptions and settings. Updated for other general changes in format and content.

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# TABLE OF CONTENTS

Content	Page
About This Manual . . . . .	5
<b>RELATED PUBLICATIONS . . . . .</b>	<b>5</b>
Admonishments . . . . .	6
General Safety Precautions . . . . .	6
Safe Working Distances . . . . .	7
<b>STANDARDS CERTIFICATION . . . . .</b>	<b>7</b>
<b>LIST OF ACRONYMS AND ABBREVIATIONS . . . . .</b>	<b>7</b>
<b>1 SYSTEM OVERVIEW . . . . .</b>	<b>1</b>
1.1 General Description . . . . .	1
1.2 Basic Components . . . . .	1
1.3 Data Flow (Forward and Reverse Paths) . . . . .	2
1.4 System Control . . . . .	4
1.4.1 System Network, CPUs, and FICs . . . . .	4
1.4.2 SNMP and MIBs . . . . .	4
1.4.3 Element Management System (EMS) . . . . .	6
1.5 Fiber Optical Transport . . . . .	7
1.6 Fault Detection and Alarm Reporting . . . . .	7
1.7 Specifications . . . . .	8
<b>2 NETWORK CONFIGURATION DETAILS . . . . .</b>	<b>14</b>
2.1 Node and Equipment Identification. . . . .	14
2.1.1 Identification Using the Network IP Receiver/Sender System . . . . .	14
2.1.2 Node Identification Schemes . . . . .	14
2.1.3 Hub Equipment Identifications. . . . .	14
2.2 MIB Relationships . . . . .	15
2.2.1 MIB Software Relationships . . . . .	16
2.2.2 MIB Hub/RAN Connection Relationships . . . . .	17
2.3 Tenant Relationships . . . . .	18
2.4 Pathtrace Format. . . . .	19
2.4.1 Pathtrace Creation. . . . .	19
2.4.2 Pathtrace Forward Transmission . . . . .	19
2.4.3 Pathtrace Forward Reception . . . . .	19
2.4.4 Pathtrace Reverse Transmission . . . . .	20
2.4.5 Pathtrace Reverse Reception . . . . .	21
2.4.6 Pathtrace Detection/Reporting . . . . .	21
<b>3 NETWORK AND SYSTEM INSTALLATION AND SETUP. . . . .</b>	<b>22</b>
3.1 Overview of Tasks . . . . .	22
3.2 Physical Check of System Components . . . . .	22
3.3 Assigning Tenants . . . . .	23
3.3.1 Understanding Tenant MIB Indexing. . . . .	23
3.3.2 BTS Connection MIB . . . . .	23
3.4 Tenant Configuration . . . . .	28

# TABLE OF CONTENTS

Content	Page
3.4.1 Setting Protocol . . . . .	28
3.4.2 Setting Channels . . . . .	28
3.4.3 Setting Hub Measured Forward Gain . . . . .	28
3.4.4 Setting RAN Measured Forward Gain . . . . .	29
3.4.5 Setting FSC Gain . . . . .	29
3.4.6 Setting RAN Forward Gain Offset . . . . .	29
3.4.7 Setting Reverse Gain . . . . .	29
3.4.8 Setting Reverse Cable Loss . . . . .	30
3.4.9 Using Tenant Reset . . . . .	30
3.4.10 Enabling FGC/RGC . . . . .	30
3.4.11 Using Tenant Mode . . . . .	30
3.4.12 Enabling/Disabling Delay Compensation . . . . .	30
3.4.13 Forward/Reverse Target Delay . . . . .	31
3.4.14 Enabling/Disabling RAN Slots . . . . .	31
3.4.15 FSC Attenuator Offsets . . . . .	31
3.4.16 Target Simulcast Degree . . . . .	32
3.4.17 Module Attenuators . . . . .	32
3.5 Managing the Tenant OAM Address and Hostname Tables . . . . .	32
3.5.1 RAN Ordering . . . . .	32
3.5.2 Bracketing of Lost RANs . . . . .	33
3.5.3 Clearing of RANs . . . . .	33
3.6 Hub Node Access/Management . . . . .	33
3.6.1 Managing Hub Nodes . . . . .	33
3.6.2 Identification Using the Network IP Receiver/Sender (NIP R/S) . . . . .	34
3.6.3 Accessing Nodes Locally . . . . .	35
3.6.4 Accessing Nodes via TCP/IP . . . . .	35
3.6.5 Using a Third Party Network Management System with Digivance CXD/NXD . . . . .	35
3.7 Configuring the Hubmaster Node . . . . .	36
3.7.1 Using the Configure-Hubmaster Script . . . . .	36
3.7.2 Using Dynamic Host Configuration Protocol With Digivance CXD/NXD . . . . .	38
3.8 Configuring the “Slave” and RAN Nodes . . . . .	39
3.8.1 Managing the Hub Node MIB . . . . .	39
3.8.2 Managing the RAN Node MIB . . . . .	41
3.9 BTS Integration . . . . .	44
3.9.1 BTS Validation . . . . .	44
3.9.2 Path Balancing . . . . .	44
3.9.3 Reverse Path Balancing . . . . .	47
3.9.4 Functional RAN Call Verification . . . . .	48
4 OTHER SYSTEM TASKS . . . . .	48
4.1 Updating System Software . . . . .	48
4.1.1 Release Notes . . . . .	48

## TABLE OF CONTENTS

Content	Page
4.2 Upgrading an Existing System . . . . .	49
4.2.1 Preliminary Steps . . . . .	49
4.2.2 Upgrade Steps . . . . .	49
4.2.3 Verification . . . . .	49
4.2.4 Failed Upgrades . . . . .	51
4.2.5 FPGA Updates . . . . .	51
4.2.6 FIC Software Upgrade . . . . .	52
4.3 Backup/Restore . . . . .	52
4.3.1 Backup . . . . .	53
4.3.2 Restore . . . . .	53
4.4 Adding/Removing SNMP Traps . . . . .	53
4.5 Updating Spare CPUs . . . . .	54
4.6 MIB Extraction . . . . .	55
4.7 Gain Management and Fault Detection . . . . .	56
4.7.1 Forward Gain Management . . . . .	56
4.7.2 Reverse Automatic Gain Control . . . . .	56
4.7.3 Forward Delay Management . . . . .	56
4.7.4 Reverse Delay Management . . . . .	56
4.7.5 Forward Continuity . . . . .	57
4.7.6 Reverse Continuity . . . . .	57
4.7.7 PA Overpower Protection . . . . .	58
4.7.8 Hub Overpower Protection . . . . .	59
5 CUSTOMER INFORMATION AND ASSISTANCE . . . . .	60

## TABLE OF CONTENTS

Content	Page
---------	------

## ABOUT THIS MANUAL

This manual provides the following information:

- An overview of the Digivance CXD/NXD system;
- A description of the CXD/NXD system Radio Access Node (RAN);
- Installation procedures for the RAN;
- Maintenance procedures for the RAN;
- Product support information.

Procedures for installing and operating other CXD/NXD system components including the system “Hub” and the EMS software that provides a user interface for the system, are available in other ADC publications, listed under “Related Publications” below, and at appropriate points within this manual.

## RELATED PUBLICATIONS

Listed below are related manuals, their content, and their publication numbers. Copies of these publications can be ordered by contacting 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). All ADC technical publications are available for downloading from the ADC web site at [www.adc.com](http://www.adc.com).

Title/Description	ADCP Number
<b>Digivance CXD/NXD Hub Installation and Maintenance Manual</b> Provides instructions for installing and operating the CXD/NXD system Hub.	<b>75-193</b>
<b>Digivance CXD/NXD SNMP Agent and Fault Isolation User Guide</b> Describes how to troubleshoot the system using the objects accessed through the CXD/NXD system SNMP agents.	<b>75-195</b>
<b>Digivance CXD/NXD Element Management System User Manual</b> Provides instructions for installing and using the Element Management System (EMS) software for the CXD/NXD system.	<b>75-199</b>
<b>Digivance NXD Multi-Band Distributed Antenna System Operation Manual</b> Provides instructions for turning up and operating NXD equipment.	<b>75-209</b>
<b>2 in. O.D. Quad Cellular/PCS Omni-Directional Antenna Installation Manual</b> Provides instructions for installing an RF antenna for the CXD/NXD system	<b>75-215</b>
<b>9 in. O.D. Quad Cellular/PCS Omni-Directional Antenna Installation Manual</b> Provides instructions for installing an RF antenna for the CXD/NXD system	<b>75-221</b>

## 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



**Warning:** *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.*



**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.*



**Caution:** *This system is a RF Transmitter and continuously emits RF energy. Maintain 3 foot (91.4 cm) 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 (5.1 cm).*



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



## SAFE WORKING DISTANCES

The Digivance CXD/NXD 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.

## STANDARDS CERTIFICATION

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

The Digivance CXD/NXD 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 are 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.

## LIST OF ACRONYMS AND ABBREVIATIONS

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

<b>AC</b>	Alternating Current
<b>ANT</b>	Multiband Antenna

<b>BIM</b>	Base Station Interface Module
<b>BTS</b>	Base Transceiver Station
<b>C</b>	Centigrade
<b>CDRH</b>	Center for Devices and Radiological Health
<b>C/MCPLR</b>	Cellular SMR Multicoupler
<b>CM</b>	Centimeter
<b>cPCI</b>	CompactPCI
<b>CPU</b>	Central Processing Unit
<b>CWDM</b>	Coarse Wave Division Multiplex
<b>CXD</b>	Compact RAN
<b>DAS</b>	Distributed Antenna System
<b>DHCP</b>	Dynamic Host Configuration Protocol
<b>dB(FS)</b>	decibals (Full Scale – digital reading)
<b>DC</b>	Direct Current
<b>DIF</b>	Digital Intermediate Frequency
<b>Div</b>	Diversity
<b>EMS</b>	Element Management System
<b>ESD</b>	Electrostatic Discharge
<b>F</b>	Fahrenheit
<b>FBHDC</b>	Full Band Hub Down Converter
<b>FDA</b>	U.S. Food and Drug Administration
<b>FCC</b>	U.S. Federal Communications Commission
<b>FIC</b>	Fiber Interface Controller
<b>FSC</b>	Forward Simulcast Card
<b>GPS</b>	Global Positioning System
<b>Div</b>	Diversity
<b>HUC</b>	Hub Up Converter
<b>IF</b>	Intermediate Frequency
<b>IN</b>	Inch
<b>IP</b>	Internet Protocol
<b>KG</b>	Kilogram
<b>LED</b>	Light Emitting Diode
<b>LSE</b>	Location Services Equipment
<b>LVD</b>	Low Voltage Disconnect
<b>MHz</b>	Mega Hertz
<b>MIB</b>	Management Information Base
<b>MTBF</b>	Mean Time Between Failure
<b>MUX</b>	Multiplexer
<b>NIPR</b>	Network IP Receiver
<b>Div</b>	Diversity
<b>NMS</b>	Network Management System
<b>NXD</b>	Digivance Neutral Host Product Line

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<b>OAM</b>	Operations Administration and Maintenance
<b>OSP</b>	Outside Plant
<b>PA</b>	Power Amplifier
<b>PAA</b>	Power Amplifier Assembly
<b>PC</b>	Personal Computer
<b>PCI</b>	Peripheral Component Interconnect bus
<b>PIC</b>	PA Interface Controller
<b>P/MCPLR</b>	PCS Multicoupler
<b>RAN</b>	Radio Access Node
<b>RDC</b>	RAN Down Converter
<b>RDC2</b>	RAN Down Converter Version 2
<b>RF</b>	Radio Frequency
<b>RSC</b>	Reverse Simulcast Card
<b>RUC</b>	RAN Up Converter
<b>RUC2.X</b>	RAN Up Converter Version 2.X
<b>RUC3</b>	RAN Up Converter Version 3
<b>SFP</b>	Small Form-Factor Pluggable Optical Transceiver
<b>SIF</b>	Sonet Interface Module
<b>SNMP</b>	Simple Network Management Protocol
<b>SONET</b>	Synchronous Optical Network
<b>STF2</b>	System Interface Module
<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>WDM</b>	Wave Division Multiplex
<b>WSP</b>	Wireless Service Provider



## 1 SYSTEM OVERVIEW

This section provides an overview of the Digivance CXD/NXD system intended for someone configuring system parameters (referred to as “objects” in the software used). This overview includes a general description of the physical components and a more detailed description of the software components because the tasks in this manual involve mostly the software components.

### 1.1 General Description

The Digivance CXD/NXD is an RF signal transport system providing long-range RF coverage in areas where it is impractical to place a Base Transceiver Station (BTS) at the antenna site. The Digivance Hub is connected via optical fibers to Radio Access Nodes (RANs) distributed over the geographical area of interest. Each RAN provides one RF antenna. The Digivance system allows the RF signals to be transported to 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.

### 1.2 Basic Components

Figure 1 shows the main components of a Digivance system, the Hub and RANs. As shown, the Hub interface with the BTS and the RAN interfaces with cellphone users. The figure shows a CXD system with dual-band SMR A and SMR B configuration.

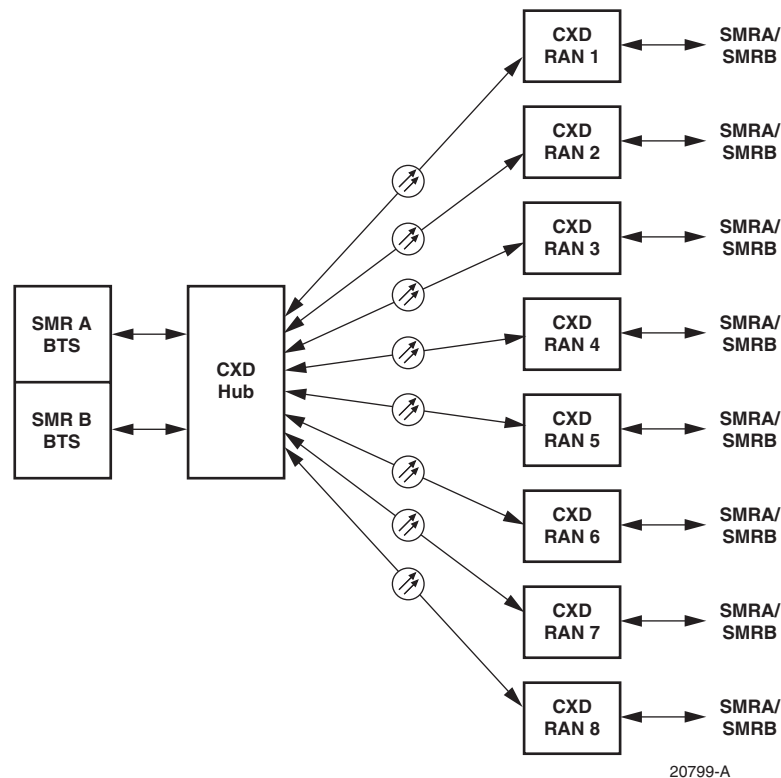


Figure 1. Digivance Architectural Summary Diagram (CXD System Shown)

The Hub is a rack assembly containing electronic equipment. Included are two types of Compact PCI (cPCI) “chassis” containing “electronic modules.” The two types of cPCI chassis are the Digital Chassis and the RF Chassis. The electronic modules include CPU boards, optical to RF data converters, an optical interface board, and so on. The Hub rack also contains other separately mounted system equipment including high power attenuators, base station interface modules, a power distribution unit, an Ethernet hub, and a Hub reference module that provides a system clock.

The RAN is weather-resistant, pole- or pad-mount cabinet containing a cPCI shelf similar to the Hub chassis and a similar set of electronic modules and supportive system equipment as required for the more limited functions required at the RAN. The CXD RAN and the NXD RAN have different sets of electronic modules, but the basic function is the same.

### 1.3 Data Flow (Forward and Reverse Paths)

Digivance CXD/NXD is a multi-frequency, multi-protocol Distributed Antenna System (DAS), providing microcellular SMR, Cellular, and PCS coverage via its distributed RF antennas. Figure 2 shows the RF signal path through a three-band CXD Digivance 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).

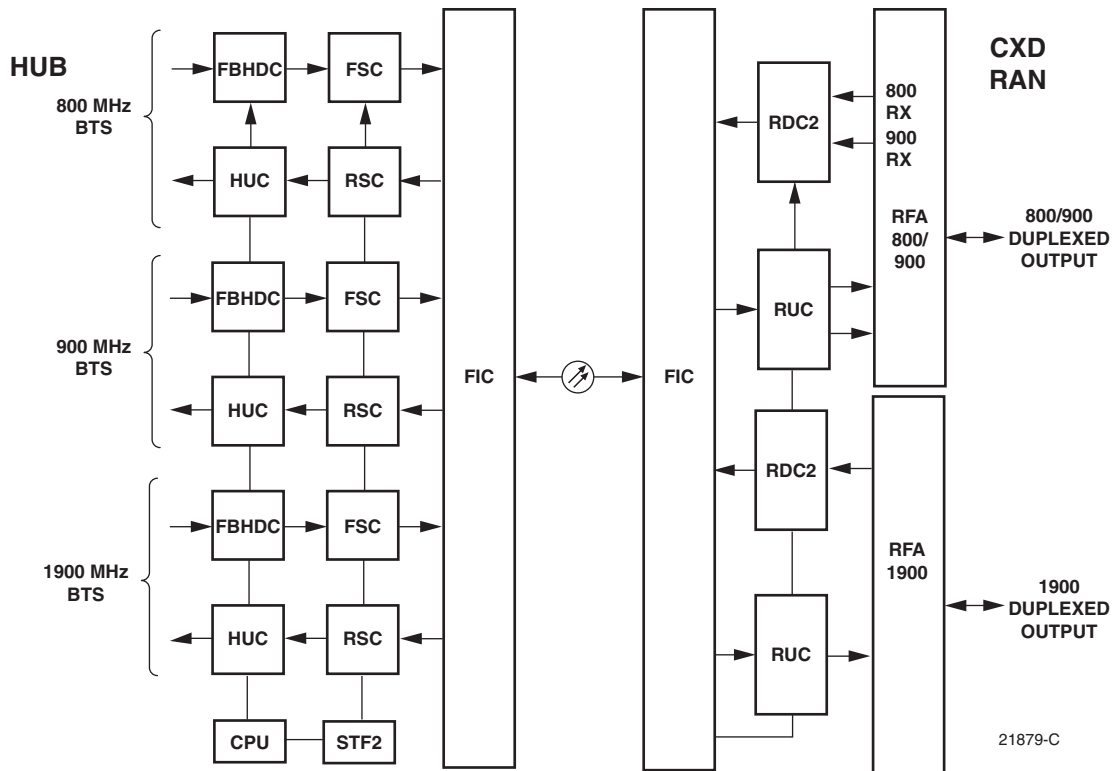


Figure 2. Digivance CXD System Block Diagram (Three Bands Shown)

On a more detailed level, in both the forward and reverse paths, the signal data passes through a series of electronic modules:

- In the forward path, the Full Band Hub Down Converter (FBHDC) receives RF signals from the BTS and down converts the signals to Intermediate Frequency (IF). The Forward Simulcast Card (FSC) digitizes the IF signals and passes digital IF (DIF) signals into the Fiber Interface Controller (FIC). The FIC converts the DIF signals to digital optical signals for transport to the RAN. At the RAN, a similar process occurs whereby the optical signals are converted to RF signals using a RAN Up Converter (RUC). The signals pass through a PAA or RFA and then are combined with other RF signals (using a combination of diplexers or triplexers) and fed into a multi-band antenna.
- In the reverse path, the antenna receives RF signals from a mobile and sends those signals through a multicoupler to the RAN Down Converter (RDC) which down converts the RF back to IF and digitizes the signals. The DIF signals are passed to the FIC, which sends digital optical signals from the RAN to the HUB FIC. The Hub FIC combines that DIF signals with DIF signals from other RANs that are in that simulcast cluster through the Reverse Simulcast Card (RSC). The Hub Up Converter (HUC) takes the RSC output and converts the digital optical signals back to RF signals for the BTS. As shown in Figure 3, the NXD system has a reverse path diplexer and a reverse path diversity signal. Reverse path diversity is an option in the CXD system.

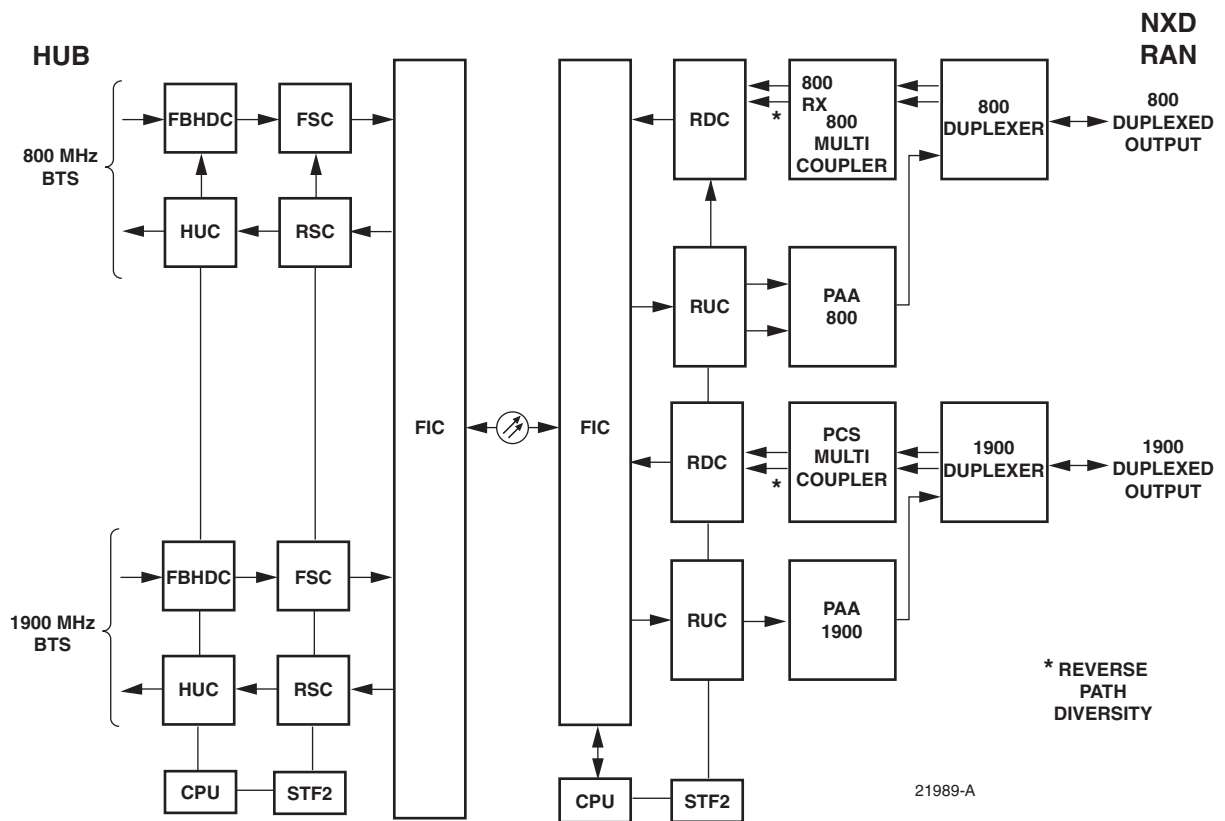


Figure 3. Digivance NXD System Block Diagram (Three Bands Shown)

## 1.4 System Control

System control in a Digivance CXD/NXD system involves three main components: (1) a LAN-type network connecting a Hubmaster CPU with other electronic modules including slave CPUs and FICs; (2) a set of alarms and settable objects provided through an SNMP interface and MIBs; (3) and an ADC graphical user interface called the Element Management System (EMS). These components are described in the following topics.

### 1.4.1 System Network, CPUs, and FICs

The top-level controller of the Digivance system is a CPU module within a Digital Chassis on the Hub rack. This CPU, called the Hubmaster CPU, runs a program that controls events in the system. The Hubmaster CPU connects with other electronic modules via Ethernet ports that act as nodes in an Ethernet-based network. This network is similar to that of a computer local area network (LAN). Network control information is passed using a portion of the bandwidth of the optical fibers connecting the Hub and RAN.

In addition to the Hubmaster CPU, the Digivance system may contain other CPUs referred to as “slave CPUs” under control of the Hubmaster. If the system is large enough to require more than one Digital Chassis in the Hub, each Digital Chassis after the first will have such a slave CPU. In addition, in an NXD system, each RAN has its own CPU which functions as a slave CPU to the Hubmaster and controls events in the RAN. By contrast, in a CXD system, the RAN has no CPU; the Hubmaster CPU directly controls the RAN through the RAN FIC

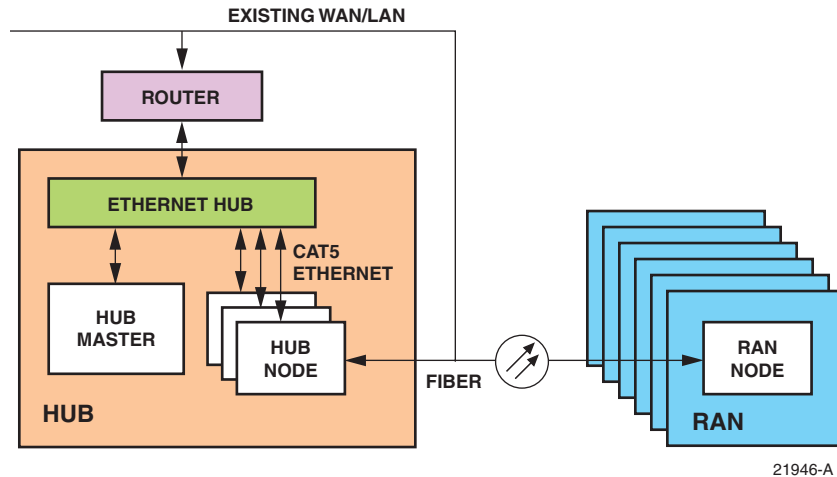


Figure 4. Network Architecture

### 1.4.2 SNMP and MIBs

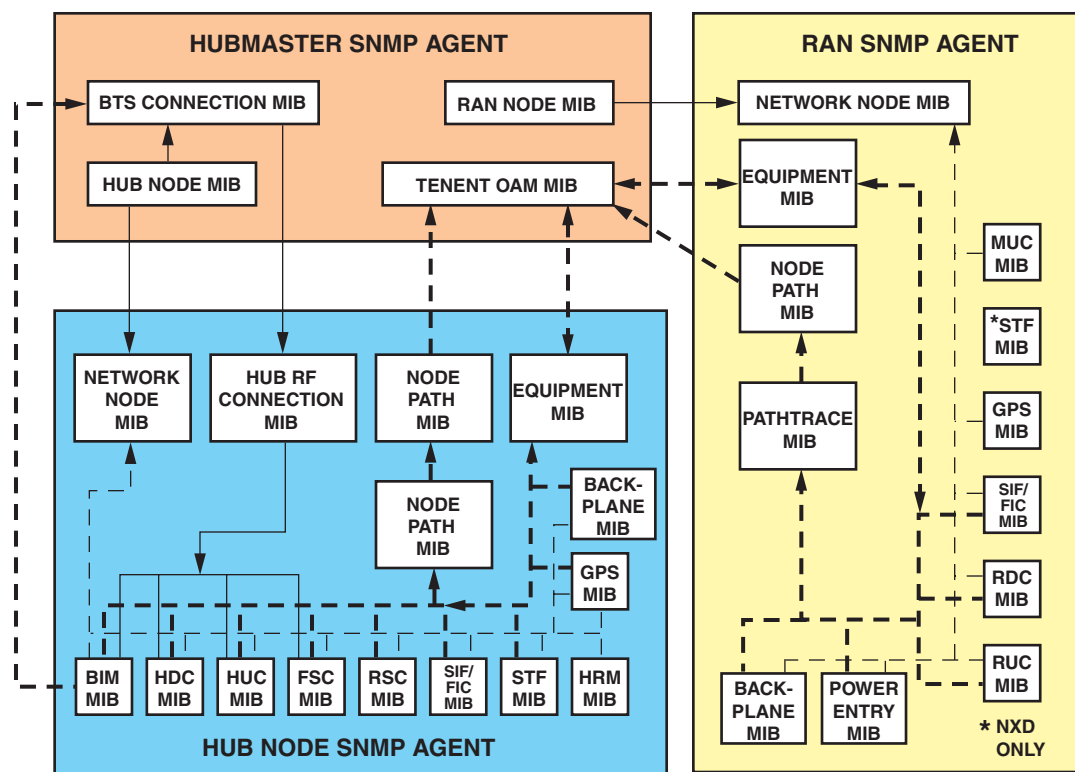
The second main component of control in a Digivance system is the logical structure of inter-related databases that is used to store and provide access to objects of interest in system management.



These databases are provided through Management Information Bases (MIBs) and an SNMP proxy agent embedded in the system software. SNMP (Simple Network Management Protocol) is an internet standard protocol enabling online devices to be queried and controlled remotely using an IP interface. A MIB is a table-like set of “objects” conforming to SNMP specifications.

Each object represents an individual alarm (such as RF overdrive in the Digivance system) or an individual object (such as Forward Skew). Via the SNMP proxy agent (which functions as a portal to the MIBs), a user is able to receive alarm indications, query for current object values, and set some object values. To do this, the user requires either a generic SNMP manager called a Network Management System (NMS) or the ADC Element Management System (EMS), both of which, in their underlying functions, conform to SNMP specifications. EMS is described in the next topic.

Figure 5 shows the MIBs used in the Digivance system, and indicates which node type each MIB is used in and how the MIBs are related to one other. Within the Digivance network, there are four node types: Hub Node, RAN Node, Location Services Equipment (LSE) node, and Hubmaster Node. “Node” is simply shorthand for “network node”.



21026-C

Figure 5. Digivance MIB Structure

In understanding the structure of nodes in the Digivance system, it is important to note that the Hubmaster node is a regular Hub node with additional functionality that is particular to the one and only Hubmaster node in the network.

The LSE node is a regular Hub node with additional functionality particular to location services applications. There is also a distinction between RAN Nodes in NXD vs. CXD systems. In an NXD system, there is a one to one relationship between CPUs and nodes because each NXD RAN has its own CPU where its own MIBs reside. In a CXD system, the term RAN Node refers conceptually to the individual RAN but all RAN MIBs reside on the Hubmaster CPU.

### 1.4.3 Element Management System (EMS)

The Digivance Element Management System is a Web based system that provides the various control and monitoring functions required for local management of each CXD/NXD system. The user interface into the EMS is a PC-type laptop computer loaded with a standard Web browser. Figure 6 is a diagram showing the relationship of EMS to the Digivance MIBs described in the previous topic.

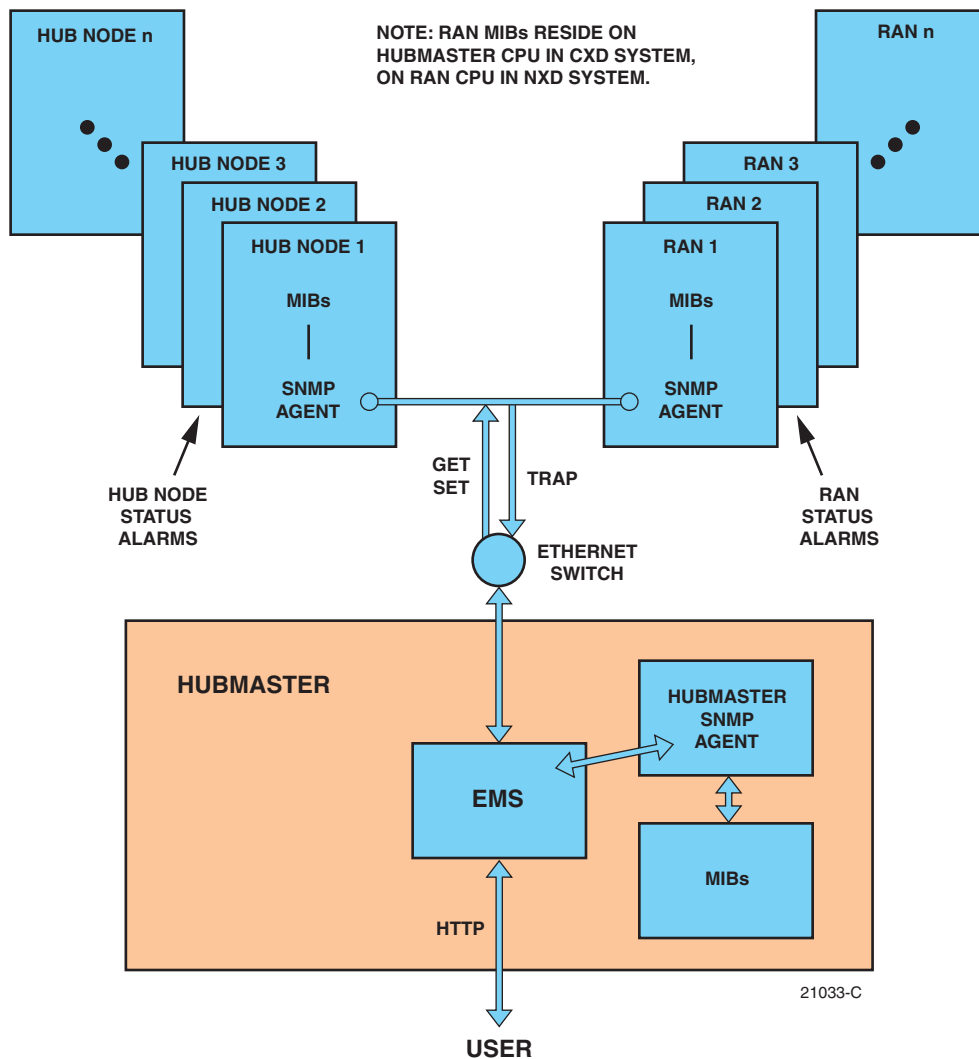


Figure 6. EMS Relationship to MIBS

All CPUs in the Digivance network support SNMP to provide NMS monitoring and access. The NMS software (whether generic or EMS) sends SNMP GET and SET messages to the various nodes in the Digivance network to access MIBs in response to a user entry.

- A GET message gets the current value of an identified object.
- A SET message sets the object to a given value. Only a limited subset of objects can be set to a new value.

► **Note:** MIBs are described in more detail in [Section 2.2 on Page 15](#).

The EMS is resident on the Hubmaster CPU and is accessible 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

## 1.5 Fiber Optical Transport

The optical signal of a Digivance system is digital. The input and output RF signal levels at the Hub FIC or the RAN FIC or 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 9 dB (typical) when used with 9/125 single-mode fiber, or 26 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.

## 1.6 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.

## 1.7 Specifications

Table 1 lists specifications for the Hub. Table 2 lists specifications for the CXD RAN. Table 3 lists specifications for the NXD RAN.

**Table 1. Hub Specifications**

ITEM	SPECIFICATION	COMMENT
<b>Hub General</b>		
Dimensions (HxWxD)	78 x 24 x 24 Inches	198.1 x 61.0 x 61.0 cm
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>Digital Chassis</b>		
Dimensions (HxWxD)	19.0 x 7.0 x 7.9 in. (body) 17.1 x 7.0 x 7.9 in. (mount)	43.4 x 17.8 x 20.1 cm 48.3 x 17.8 x 20.1 cm
Color	Brushed aluminum	
Backplane connections	RJ-45	
Power Input	-48 VDC	Floating
Power Consumption		Typical
Digital Chassis	76.0 Watts	Fans and 12 VDC P/S
CPU	20.2 Watts	
STF2	3.5 Watts	
RSC	8.8 Watts	
FIC	15.2 Watts	
<b>RF Chassis</b>		
Dimensions	19.0 x 7.0 x 7.9 in. (body) 17.1 x 7.0 x 7.9 in. (mount)	43.4 x 17.8 x 20.1 cm 48.3 x 17.8 x 20.1 cm
Color	Brushed aluminum	
Backplane connections	RJ-45	
Power Input	-48 VDC	Floating

**Table 1. Hub Specifications, continued**

ITEM	SPECIFICATION	COMMENT
Power Consumption RF Chassis FBHDC HUC FSC	55.0 Watts 11.0 Watts 7.7 Watts 13.5 Watts	Typical Fans and 12 VDC P/S
<b>Base Station Interface Module (BIM)</b>		
Dimensions (HxWxD)	17.1 x 1.75 x 7.9 inches (body)	43.4 x 4.4 x 20.1 cm
Color	Brushed aluminum	
I2C connections	RJ-45	
RF connections	50 ohm SMA-type (female)	50 ohm input/output impedance
Power Input	-48 VDC	Floating
Power Consumption	20 Watts	Typical
<b>Hub Reference Module (HRM)</b>		
Dimensions (HxWxD)	17.1 x 1.75 x 7.9 inches (body)	43.4 x 4.4 x 20.1 cm
Color	Brushed aluminum	
Clock, 9.6 MHz signals and I2C connections	RJ-45	
RF connections	50 ohm SMA-type (female)	50 ohm input/output impedance
RS-232 connection	DB-9	
Power Input	-48 VDC	Floating
Power Consumption	17 Watts	Typical
<b>Optical – Hub SFP</b>		
Fiber type	9/125, single-mode	
Number of fibers required Without WDM With WDM With CWDM	2 1 1 per 4 RANS	Requires CWDM optical transceivers and wavelength division multiplexers (WDM) which are accessory items.
Optical transceiver type	SFP	
FWD & REV path wavelength Standard range	1310 nm 1550 nm	Standard range Extended range
Optical transmit power output	0 dB m 0 dB m	Standard range (typical) Extended range (typical)
Optical receive input	-9 dBm -26 dBm	Standard range Extended range
Optical budget	9 dB 26 dB	Standard range (typical) Extended range (typical)
Optical connectors	LC	Dual-connector

**Table 2. CXD RAN specifications**

ITEM	SPECIFICATION	COMMENT
Dimensions (HxWxD) CXD RAN Standard Cabinet CXD RAN Extended Cabinet	23 x 18 x 11 Inches 23 x 18 x 17 Inches	2.6 cubic feet 4.1 cubic feet
Weight CXD RAN Standard Cabinet CXD RAN Extended Cabinet Pole mount bracket	23 lbs. (10.45 kg.) 49 lbs. (45.45 kg.) 7 lbs. (3.18 kg.)	Empty, no modules Empty, no modules Metal and wood pole brackets
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)	
Cold-start temperature	-20° C (-4° F)	
Storage temperature	-40° to +85° C (-40 to 185° F)	
Humidity	10% to 90%	
IP interface	RJ-45	
AC power ingress	¾-inch box spacer	Threaded fitting
Fiber optical cable ingress	¾-inch service entrance cable fitting	
Power input	100 to 240 VAC	47 to 63 Hz
Battery backup options Internal – RFA Slot Assembly External	1 hour 2 hour	Takes one RFA slot Requires Extended Cabinet
Battery Weight Internal – RFA Slot Assembly External	61 lbs. 140 lbs.	Two batteries and tray Two batteries
Power consumption	600 W	Two 10 W PA option
Reliability at 25°	MTBF 50,000	Excluding fan assemblies
<b>Optical 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	

**Table 2. CXD RAN specifications, continued**

ITEM	SPECIFICATION	COMMENT
Optical transmit power output Standard range Extended range	0 dBm 0 dBm	Typical
Optical receive input Standard range Extended range	-9 dBm -26 dBm	
Optical budget Standard range Extended range	9 dB 26 dB	Typical
Optical connectors	LC	Dual-connector
Battery backup options Internal – RFA Slot Assembly External	1 hour 2 hour	Takes one RFA slot Requires Extended Cabinet
Battery Weight Internal – RFA Slot Assembly External	61 lbs. 140 lbs.	Two batteries and tray Two batteries

**Table 3. NXD RAN Specifications**

ITEM	SPECIFICATION	COMMENT
<b>Physical and Mechanical</b>		
Dimensions (HxWxD)	36.5 x 31.0 x 24.0 inches (92.7 x 78.7 x 60.1 cm)	
Weight with extended batteries (4)	300 lbs. (136.4 kg) 625 lbs. (284.1 kg)	RAN without batteries Total RAN + 4 batteries
Color	Putty white	
Bands per box	Up to 4	
Boxes per RAN site	Up to 2 RANs	
RF connections	RAN cabinet has 5 Type N plugs	Cable type: CommScope PN 540ANM or equivalent
<b>Environmental and Thermal</b>		
Box thermal management	External air	Variable speed fans (PIC/PA Assembly and cPCI)
Operating temperature	-40 to +50 degrees C	-40 to 122 degrees F
Cold-start temperature	-20 to +50 degrees C	-4 to 122 degrees F
Storage temperature	-40 to +85 degrees C	-40 to 185 degrees F
Internal air temperature	0 to 60 degrees C	32 to 140 degrees F
Weather resistance	NEMA-3R	
Operational humidity	95%	
Acoustic emissions	63 dBA	

**Table 3. NXD RAN Specifications**

ITEM	SPECIFICATION	COMMENT
<b>Power</b>		
AC power ingress	240 VAC, 20 Amps, single phase	
Battery backup options extended glitch	120 minutes 5 minutes	-48 volts @25 degrees C (degrees F) for four bands
RAN box power use	2700 Watts Max. 16 Amps Max.	
cPCI rack power	-48 VDC	
<b>Optical</b>		
Fiber cable ingress	Nylon connector accommodates cable diameters in range 0.38- 0.50 inches (0.97-1.27 cm).	For larger cable sizes, refer to the note in .
Fiber type	Corning SMF-28 or equivalent	
Optical connectors	LC	Standard on SFP transceivers
Insertion loss	0.2 dB Typical, 0.4 dB Max.	
Number of fibers required	1-4 fiber runs per RAN	
Fiber configuration	Star (point to point) or ring	Ran ring limited to 3 SIFs
Fiber data link protocol	OC-48	
Wavelengths per fiber with WDM option with CWDM option	1 (1310 nm) 2 (1310/1550) 8 (1470-1610)	Without WDM/CWDM option  20 nm increments (ITU-GRID)
Optical transceiver type	SFP	Dual LC connector
Optical Tx power	-3 dBm Max, -10 dBm Min.	Finistar FTRJ-1320-1 (or equivalent)
Optical Rx sensitivity	-22 dBm Typical, -18 dBm Max.	
Optical link margin	2 dB	Estimated
Optical link loss	6 dB	Estimated
Optical Rx saturation level	-3 dBm	Min. Max. operational power
Optical Rx damage level	-3 dBm	Min. Max survivable power
Optical safety class	1	ANSI Z 136.2
<b>RF</b>		
Tuning frequency PCS band Cellular band SMR 800 band SMR 900 band	Receive Path 1850-1910 MHz 824-849 MHz 806-824 MHz 896-901 MHz	Transmit Path 1930-1990 MHz 869-894 MHz 851-869 MHz 935-940 MHz
Instantaneous bandwidth	15 MHz	



**Table 3. NXD RAN Specifications**

ITEM	SPECIFICATION	COMMENT
Receiver noise figure PCS band Cellular band	6 dB 5 dB	Measured at Hub output connector (BIM, RxP) without BTS at 10 dB gain and a single RAN
Input IP3	-21 dBm	Two tone tests at -56 dBm
Received signals In band Out of band +/- 8.5 MHz Out of band +11/-13 MHz Out of band +13/-16 MHz	-41 dBm -3 dB -43 dB -83 dB	RDC capability (at cabinet input) A/D clip level, single RF channel Selectivity (function of SAW filter) Selectivity Selectivity
Automatic gain control  Gain control range	  30 dB	Activated if A/D clips, changes gain of A/D and gain in digits. Design ensures analog gain and digital gain change will be timed correctly. 15 dB noise figure at -14 dB gain
Gain in series with BTS	-10 to +10 dB	Lower limit for simulcast with a host tower site, the max reduces effect of cascaded noise figure
Gain parallel to BTS	0 to +30 dB	Allows injection after BTS amplifiers
Gain stability	+/- 2dB	Over temperature, frequency, and aging valid for input signals below AGC threshold
System Bandwidth Forward Path Reverse Path	15 MHz block increments 15 MHz block increments	
Impedance	50 ohm	
Output Power Cellular/SMR 10 Watt MCPA PCS 20 Watt MCPA	6.5 Watts (+38 dBm) composite 12.5 Watts (+41 dBm) composite	At antenna port At antenna port
Gain resolution	1 dB	
Gain measurement		Configured at startup using factory calibration of modules and user data

## 2 NETWORK CONFIGURATION DETAILS

This section provides details on items that are important to understand when configuring the Digivance system.

### 2.1 Node and Equipment Identification

In the Digivance CXD/NXD system, a “node” is a hardware focus of activity. The main Hub CPU (the system’s Master CPU) and the RANs are each a separate node. They are referred to as the “Hubmaster Node” and “RAN Nodes.” In a large system, there may be additional CPUs at the Hub. These CPUs are configured as Slave CPUs and are referred to as “Hub Nodes.” RAN Nodes are Slave CPUs (in an NXD system) or FICs (in a CXD system) located in a RAN cabinet. “Equipment” in a CXD/NXD system is comprised of functionally separate items such as chassis and electronic modules that each have a predetermined physical location on a Hub rack or within a RAN cabinet.

#### 2.1.1 Identification Using the Network IP Receiver/Sender System

The Hubmaster Node dynamically keeps track of which nodes are under its control using a script called NIPR (Network IP Receiver). The Hubmaster Node 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 Hubmaster DNS accordingly. The NIPR/S system is also a key component to maintaining the Hub/RAN Node MIBs and tenant processing, since it is the mechanism by which the Hub/RAN Node MIB entries are filled. For more on these MIBs, see [Section 3.8 on Page 39](#).

#### 2.1.2 Node Identification Schemes

It is important to follow a convention when naming nodes in the Digivance system so that the nodes 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 topics. For more information concerning node identity configuration, refer to [Section 3.8 on Page 39](#).

#### 2.1.3 Hub Equipment Identifications

[Table 4](#) shows the recommended convention to be used for identifying and placing Hub equipment:

**Table 4. Hub Rack Numbering**

CHASSIS OR SHELF HEIGHT	LOCATION*
Attenuator Shelf 2U	U42
PDU 2U	U40

**Table 4. Hub Rack Numbering**

CHASSIS OR SHELF HEIGHT	LOCATION*
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

\*'U' numbers are printed on the rack rails of the OP-HUB2 rack.

Hub Racks are numbered sequentially: Rack1, Rack2, and so on, or by serial number. The following guidelines apply:

- Chassis in Hub racks are numbered by 'U' number. For example, the lowest RF chassis shown in [Table 4](#) would be numbered U12.
- BIMs in racks are numbered by 'U' number. For example, the lowest BIM shown in [Table 4](#) 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.

## 2.2 MIB Relationships

As explained in [Section 1.4.2 on Page 4](#), the Digivance CXD/NXD system uses Management Information Bases (MIBs) accessed with an SNMP manager (or EMS) to provide a user interface for querying and configuring performance objects and being notified of alarms. This section describes the relationships between MIBs that are relevant when configuring and operating the system.

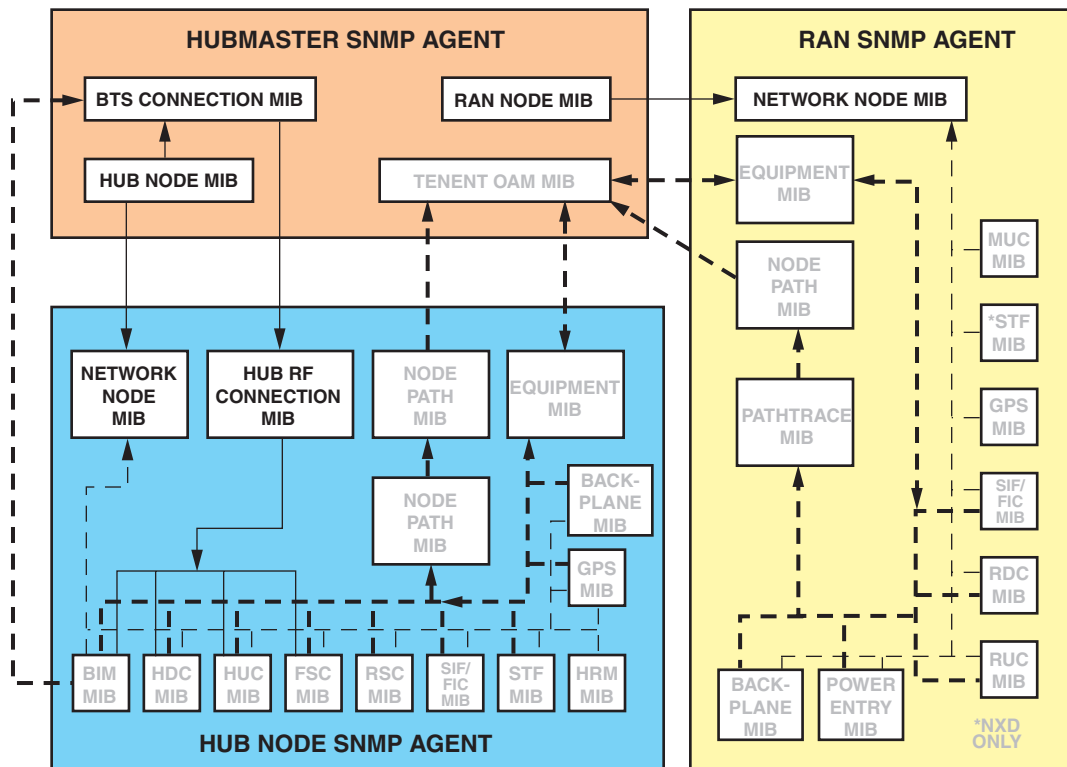
### 2.2.1 MIB Software Relationships

In [Figure 7](#), the solid lines between the Hubmaster and Hub/RAN nodes illustrate Hub/RAN connection relationships.

As shown in the figure, the Hubmaster contains a process called the Hub/RAN Config Process. This process is responsible for managing the connections between the Hubmaster and the other nodes in the network. The Hub/RAN Config Process uses the Hub Node MIB and RAN Node MIB to manage these connections. The Hub/RAN Node MIBs allow specific information about the Hub/RAN nodes to be configured. This information is represented by such objects as Site ID and Pole ID. Other objects represent RAN hardware connections.

The Hub/RAN Config Process will push the information configured in these MIBs down to the Network Node MIB at each node. It is also responsible for preparing the Hubmaster to have tenant relationships established. The Hub/RAN Config 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 [Section 3 on Page 22](#) for a description of the individual MIB objects that are involved Hub/RAN Config Process.



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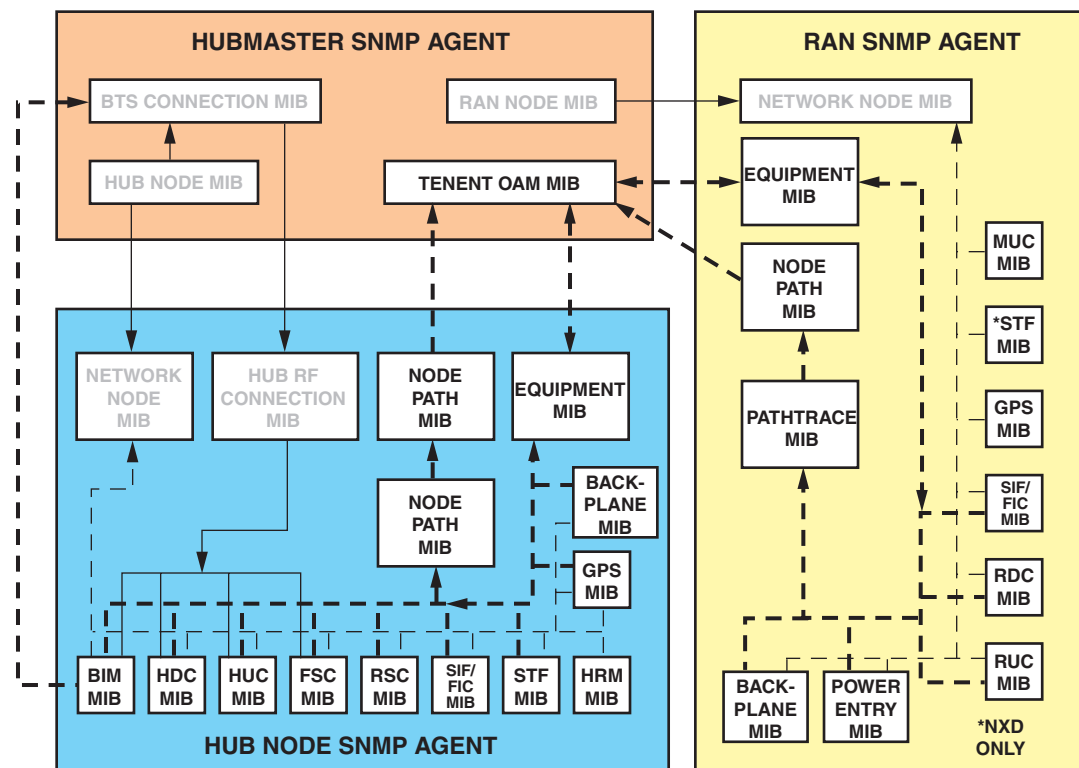
Figure 7. Digivance MIB Structure

### 2.2.2 MIB Hub/RAN Connection Relationships

In Figure 8, the dashed lines seen in the Hub and RAN Nodes show the relationships among MIBs associated with specific hardware modules. As shown, a separate software HCP (hardware control process) is used to manage each hardware module in a node. The HCP MIBs are the interface to these HCPs. A single MIB instance is used in each node for each type of hardware (FBHDC, RDC, and so on).

Each Hub Node and RAN Node contains a Bus Scanner process. The responsibility of this process is to discover the presence or absence of hardware modules and to start or stop HCPs to manage those hardware modules. The Bus Scanner MIB reports the information defining the hardware “discovered” at that node.

Each node also contains a Network Node process to manage information about that CPU or FIC, where the interface is the Network Node MIB. The Network Node MIB contains information about the CPU or FIC itself (for example, IP Address, Hostname, and so on), Hub/RAN specific information (for example, Pole ID, RAN Box ID, and so on), and other miscellaneous status information. In addition, the Network Node 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.



21943-A

Figure 8. Digivance MIB Structure

## 2.3 Tenant Relationships

In [Figure 8](#) on the previous page, the dotted lines among Hubmaster and Hub/RAN nodes illustrate tenant relationships.

Once a tenant is created using the BTS Connection of the previous section, a Tenant process is launched to manage that new tenant. This tenant process uses the Tenant OAM MIB in the Hubmaster node to allow tenant specific objects to be configured. These objects 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 MIBs 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 MIBs located at each node in the network. If the Equipment MIB indicates that there is hardware belonging to that tenant on that node, the Tenant process in the Hubmaster will add that node to its “managed node” list. The Tenant process will then use the Equipment MIBs 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 Hubmaster 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 MIBs 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 MIBs.

## 2.4 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/NXD 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 their 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 on 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*

### 2.4.1 Pathtrace Creation

Pathtrace is automatically created using information contained in the BTS Connection MIB.

### 2.4.2 Pathtrace Forward Transmission

Though the BIM, FBHDC, and FSC all create the pathtrace string and report it in their MIBs, the FSC is the originator of the pathtrace string in the forward path of the system. The pathtrace string will be routed to all RANs belonging to this tenant.

### 2.4.3 Pathtrace Forward Reception

In the forward path, the SIF or FIC modules in the Hub that are connected to the FSC outputs, as well as the SIFs or FICs in the simulcasted RANs, pass-through the pathtrace strings from their inputs to their outputs. In addition, the SIF Hardware Control Process (HCP) report the passed-through pathtrace strings in the SIF or FIC MIB for use by tenant processing and other higher-level processes.

In each of the simulcasted RANs, 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.

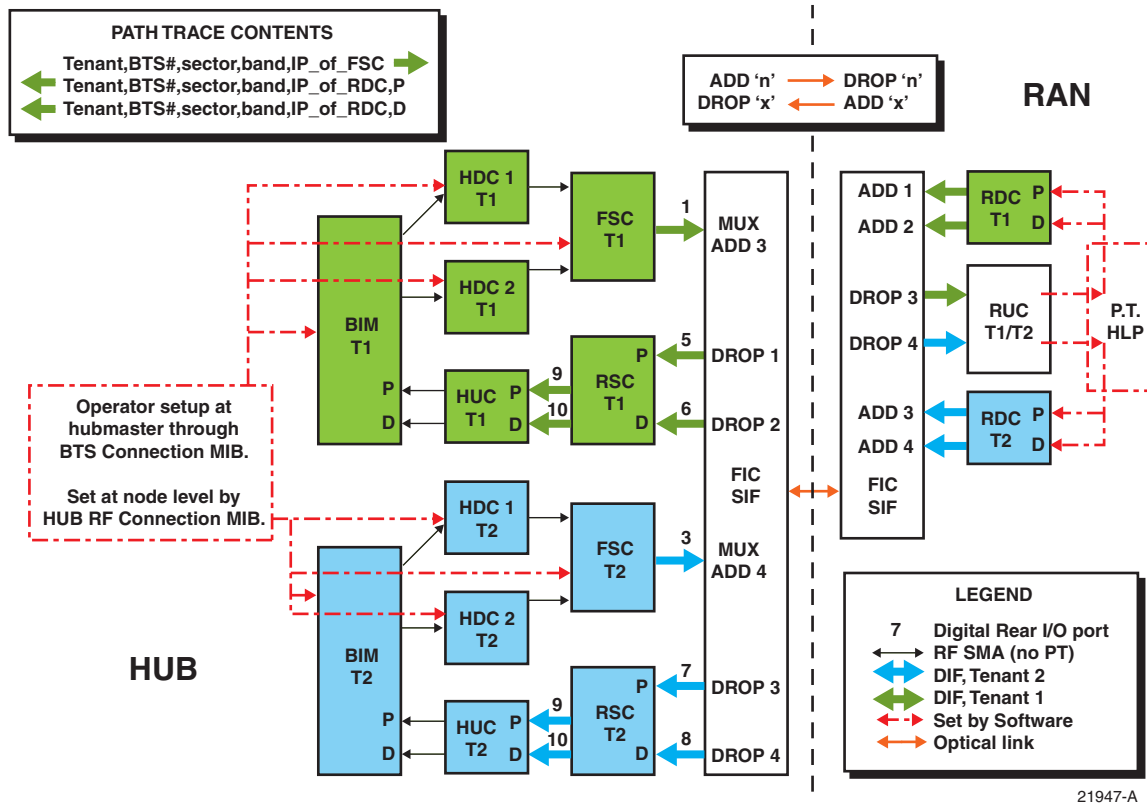


Figure 9. Tracing Pathtrace, Two Tenants

### 2.4.4 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 MIBs of the RDCs that are associated with the RUCs.

The RDC HCP creates up to two new pathtrace strings (primary/diversity(if present)) 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 transmits the pathtrace strings out on up to two outputs. The pathtrace strings are then transmitted back to the Hub reverse modules belonging to this tenant.



### 2.4.5 Pathtrace Reverse Reception

In the reverse path, the SIF or FIC modules in the RANs that are connected to the RDC outputs, as well as the SIFs or FICs in the Hub, pass-through the pathtrace strings from their inputs to their outputs. In addition, the SIF/FIC HCPs report the passed-through pathtrace strings in the SIF MIB for use by tenant processing and other higher-level processes.

In the Hub, the RSC module receives the pathtrace strings from several RDCs 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).

The HUC module receives the reverse pathtrace strings into its FPGA from up to 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.

### 2.4.6 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 MIBs 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 Hubmaster node, the Tenantscan process is responsible for examining the Node Paths MIBs 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 MIB are updated.

The Tenant processes in the Hubmaster node are responsible for updating the Equipment MIBs 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 Hubmaster 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.

### 3 NETWORK AND SYSTEM INSTALLATION AND SETUP

This section discusses the steps necessary to set up the Digivance CXD/NXD system communications and operating objects. 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.

#### 3.1 Overview of Tasks

Table 5 lists the main tasks done in system setup and indicates the topic in this manual containing detailed information for the identified task.

► **Note:** Except for the first, all of these tasks involving setting SNMP objects and are done using an SNMP manager or the ADC Element Management System.

**Table 5. System Setup Tasks**

ITEM	SPECIFICATION	FOR DETAILS REFER TO
1	Do a physical check of system components	<a href="#">Section 3.2 on Page 22</a>
2	Assign tenants	<a href="#">Section 3.3 on Page 23</a>
3	Configure tenants	<a href="#">Section 3.4 on Page 28</a>
4	Manage the Tenant OAM Address and Hostname tables	<a href="#">Section 3.5 on Page 32</a>
5	Configure the Hub Nodes	<a href="#">Section 3.6 on Page 33</a>
6	Configure the Hub and Ran slave nodes	<a href="#">Section 3.7 on Page 36</a>

#### 3.2 Physical Check of System Components

Before beginning on system configuration, check to ensure that the physical components of the system have been cabled correctly and installed in the correct location.

Use the following procedure:

1. Ensure that RF cables from the BIM forward output ports are connected to FBHDC modules in its related HUB RF chassis (not used if BTS is directly cabled to FBHDC).
2. Ensure that RF cables from the BIM reverse input ports are connected to HUC modules (primary to primary and diversity to diversity (if diversity is used)). Ensure that any HUC and FBHDC modules connected to a given BIM must reside in the same Hub RF chassis.
3. Ensure that FBHDC modules are connected to FSC modules. (For details, refer to the Hub installation manual, ADCP-75-193.)

4. Ensure that the electronic modules within the RF chassis are in the correct position. An RF chassis in a Hub rack contains enough slots for two sets of tenant RF equipment, where a set of tenant RF equipment consists of one FSC, one HUC, and up to two FBHDCs. 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, FBHDC, FSC, and FBHDC. 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 6](#) for more details.

**Table 6. RF Chassis Configuration**

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

### 3.3 Assigning Tenants

#### 3.3.1 Understanding Tenant MIB Indexing

Throughout the Digivance system, there are several MIBs that are used to monitor and control tenant activity. These tenant-based MIBs contain tables with 96 separate objects, where each object in the 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 tenant-based MIBs.

► **Note:** The Digivance CXD/NXD system can support up to 96 unique Base Station Sectors per Hubmaster CPU.

#### 3.3.2 BTS Connection MIB

Within the Hubmaster 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 system. In order to create a new tenant in the Digivance system, the Hub Config Process in the Hubmaster 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 (described in [Section 2.1 on Page 14](#)) are known.

The software in the Hubmaster continues to send requests to all configured Hub Nodes to determine if there are any BIM modules that have come online. When a new 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 “Unconfigured”, 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.

For ease of setup, when a new BIM module is found, the required BTS Connection MIB is automatically filled in with default values. These values can be changed manually by the user (see section 6.2.6. for details).

► **Note:** In EMS, the BTS Connection MIB (Tenants Table) is accessed from the menu tree by selecting **Configuration-Tenants**. The object names given here (for example, Tenant Name) are the names that the objects have in the Tenants Table.

### 3.3.2.1 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.*

### 3.3.2.2 Setting the BTS ID

The BTS ID identifies the BTS being used by the WSP for this particular tenant. Since WSPs may have more than one base station (BTS) in the system, it is important to uniquely identify each one. The allowable value is a string of 1-8 characters. The MIB field is:

*transceptBtsConnectionTable.transceptBtsConnectionBTSID.*

### 3.3.2.3 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.*

### 3.3.2.4 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/NXD 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  
 US800SMRA (10) – SMR 800 band (806-821/851-866MHz)  
 US800SMRUpper (11) – SMR 800 band Extended (818-824/862-869MHz)  
 US900SMRB(12) – SMR 900 band  
 US1900G (13) - PCS band G

The MIB field is:

*transceptBtsConnectionTable.transceptBtsConnectionTenantBand*

### 3.3.2.5 Setting the BIM Rack/Shelf ID

The location information (rack/shelf) of the BIM module belonging to this tenant can be manually configured. The valid values for these MIB fields are strings of 1-16 characters. 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*

### 3.3.2.6 Designating the Tenant Hardware

The BTS Connection MIB contains several fields pertaining to the location of the tenant-specific hardware. Some of the connections made between hardware are not automatically detectable, and therefore may require some manual entering of information.

The I2C addresses of the RF modules belonging to the tenant being configured can be set (if changes from default values are required) 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 one FBHDC modules. Select the I2C Bus of the FBHDC module that matches the BIM I2C bus value. Set the FBHDC I2C slot value to “1”. The FBHDCs belonging to a single tenant (i.e. having RF connections to the same BIM module) should be co-located in the RF chassis, with an FSC and HUC modules separating them. The MIB fields are:

*transceptBtsConnectionTable.transceptBtsConnectionHdcXI2cBus*

and

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

- The FBHDC module belonging to this tenant is cabled to a single FSC module, which is located in a chassis slot directly above the tenant's FBHDC module. Select the I2C Bus and Slot of the FSC module to that of its corresponding BIM. Set the I2C slot value to “2”. 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 FBHDC and FSC modules belonging to this tenant. Set the I2C Bus of the HUC module to that of its corresponding BIM. Set the I2C slot value to “0”. 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.

### **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*

### 3.3.2.7 HUC Invalid Config

The BTS Connection MIB contains a read-only field that reports the state of the HUC 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.*

### 3.3.2.8 Composite Mode

The Digivance CXD/NXD default forward gain balance is called “composite mode.” In this mode, a composite RF signal will have gain of +42dB (Cell/SMR) and +45dBm (PCS) through the system. The maintainer is responsible for ensuring the desired signal level into the system. See Table 3-3 for sample input and output signal strengths:

**Table 7. Output Signal Strength**

INPUT (RMS AT FBHDC INPUT)	CELL/SMR OUTPUT (RMS AT ANTENNA PORT)	PCS OUTPUT (RMS AT ANTENNA PORT)
-2 dBm	+40 dBm	+43 dBm
-4 dBm	+38 dBm	+41 dBm
-7 dBm	+35 dBm	+38 dBm

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 Section 7 Tenant Configuration. The MIB field is:

*transceptBtsConnectionForwardGainTable.transceptBtsConnectionForwardGainCompositeModeFlag*

### 3.3.2.9 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 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.*

## 3.4 Tenant Configuration

The Tenant Operations Management and Maintenance (OAM) MIB is the primary interface for configuring the operating objects of tenants in the Digivance CXD/NXD system. The Tenant OAM MIB is used exclusively at the Hubmaster node, where any changes made to operating objects are validated and pushed down to the proper node(s) by Tenant processing.

► **Note:** In EMS, the Tenant OAM MIB is accessed from the menu tree by selecting **Configuration-Tenants** . .

► **Note:** For a background on tenant relationships, refer to [Section 2.3 on Page 18](#).

### 3.4.1 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/NXD 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).

### 3.4.2 Setting Channels

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

Each Tenant sector in the Digivance CXD/NXD system can support from 1-8 RF paths. Each of these RF paths can be individually enabled in the Tenant OAM MIB.

► **Note:** In Composite Mode, one (1) RF path is automatically enabled.

### 3.4.3 Setting Hub Measured Forward Gain

*transceptTenantOAMTable.transceptTenantHubMeasuredForwardGain*

This object is no longer used in the Digivance CXD/NXD system.



### 3.4.4 Setting RAN Measured Forward Gain

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

This object is no longer used in the Digivance CXD/NXD system.

### 3.4.5 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”.

### 3.4.6 Setting RAN Forward Gain Offset

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

The RAN Forward Gain Offset is a object 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 object in the Tenant OAM MIB for each RAN in a tenant simulcast group. The valid range of values for these objects is -120 to +80, which is -12 to +8 dB in 1/10 dB units.

► **Note:** It is possible to overdrive the forward path, which will cause the PA to fault and shut down.

### 3.4.7 Setting Reverse Gain

*transceptTenantOAMTable.transceptTenantReverseGain*

The Reverse Gain object in the Tenant OAM MIB allows the Reverse Gain Target to be set. This value sets the gain for the entire reverse path. The valid range of values for this object is -100 to +100, which is -10 to +10 dB in 1/10 dB units. The system assumes a 20 dB pad between the BIM and the BTS. If the 20 dB pad is not used then the +/- 10 dB gain setting maps to +10 to +30 dB of gain.

### 3.4.8 Setting Reverse Cable Loss

*transceptTenantOAMTable.transceptTenantReverseCableLoss*

Reverse Cable Loss is a object in the Tenant OAM MIB to allow the signal loss due to cabling between the base stations and the Digivance CXD/NXD system to be factored into the reverse gain management processing. This object has a valid range of values of 0 to 450, which is 0 to +45 dB in 1/10 dB units. The maximum cable loss between the BTS and the BIM is 45 dB.

### 3.4.9 Using Tenant Reset

*transceptTenantOAMTable.transceptTenantReset*

Tenant Reset is a object 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/NXD software.

### 3.4.10 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 objects 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.

### 3.4.11 Using Tenant Mode

*transceptTenantOAMTable.transceptTenantMode*

Tenant Mode is a object in the Tenant OAM MIB that will allow the tenant to be put into a special mode such as “disabled”, or “test”,. This functionality is not currently supported in the Digivance CXD/NXD software.

### 3.4.12 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 objects 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.

### 3.4.13 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 195,000 ns with a default of 100,000 ns.

### 3.4.14 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 objects 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. For example:

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

### 3.4.15 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 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.

### 3.4.16 Target Simulcast Degree

In order for the Digivance CXD/NXD software to determine the correct number of tenant paths throughout the system, it can 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 object. This MIB object accepts values ranging from 1-8, the range of simulcasting supported in Digivance CXD/NXD on a per sector basis.

### 3.4.17 Module Attenuators

In order to be consistent with all other configuration objects in the system, and to ensure that configuration data is properly managed, the Tenant OAM MIB contains several objects to allow the configuration of tenant module attenuators. When configured in the Tenant OAM MIB, tenant processing will push these attenuators offsets 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 (see Path Balancing, Section 4, Subsection 2). It is also important to note that the attenuator offset values configured in the Tenant OAM MIB will supercede (and therefore overwrite) those configured in the HCP MIBs.

The following is the list of all supported tenant attenuators in the Tenant OAM MIB:

- *TransceptTenantGenTwoTable.transceptTenantRucYAttenOffset* - Y = RAN 1-8.
- *TransceptTenantGenTwoTable.transceptTenantRdcYAttenOffsetPrimary* - Y = RAN 1-8.
- *TransceptTenantMoreAttenTable.transceptTenantRdcYAttenOffsetDiversity* - Y = RAN 1-8.
- *TransceptTenantMoreAttenTable.transceptTenantBimForwardAttenZOffset* - Z = Path 1-2.
- *TransceptTenantMoreAttenTable.transceptTenantHdcChXAttenOffset* - X = Channel 1-8.

## 3.5 Managing the Tenant OAM Address and Hostname Tables

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

### 3.5.1 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 RANs. When Tenant processing discovers new RANs 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 objects, 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 Hubmaster CPU and other CPU/FICs in the network, which will allow the NMS to program the RAN IDs when new RANs are added to the tenant simulcast group.

### 3.5.2 Bracketing of Lost RANs

When a RAN CPU/FIC 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 four octet values with decimal points separating the octets, then that RAN should be considered not present.

### 3.5.3 Clearing of RANs

In order to facilitate swap outs of RAN CPU/FICs, it is possible for the RAN Hostname values in the Hostname table of the Tenant OAM MIB to be cleared by deleting the hostname from the MIB table. Doing so will allow that RAN ID to be cleared, and will allow the next RAN CPU/FIC discovered to occupy that RAN ID.

## 3.6 Hub Node Access/Management

### 3.6.1 Managing Hub Nodes

The Hub in a Digivance CXD/NXD 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/NXD 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 Hubmaster nodes. Refer to Section 11.1 for details.

### 3.6.2 Identification Using the Network IP Receiver/Sender (NIP R/S)

The Digivance CXD/NXD Hubmaster node dynamically keeps track of which nodes are under its control using a script called NIPR/S (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 Hubmaster DNS accordingly. The NIPR/S script is also a key component to maintaining the HUB/RAN Node MIBs 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 Hubmaster node. To get an unbroken list of Digivance CXD/NXD IP addresses that the Hubmaster is currently servicing, telnet into the Hubmaster 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 Hubmaster is always the first entry in the list.

An example of a typical output for a five-node system is shown in [Figure 10](#).

```
+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 10. 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.

### 3.6.3 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/NXD 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.

### 3.6.4 Accessing Nodes via TCP/IP

To perform some installation maintenance activities, the network operator will need to log into Digivance CXD/NXD 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/NXD nodes. Nodes can always be accessed by IP address. These three access types are available for Windows and Unix strains.

There are two default user accounts that come standard in the Digivance CXD/NXD network. The "operator" account has access to the Digivance CXD/NXD 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 "soda" privileges, which may be modified by the network operator to tailor operator access. To learn more about "soda", log onto any Linux operating system and type "man soda" at the prompt. Note that, among other privileges, a "root" user can create more user accounts on each node.

### 3.6.5 Using a Third Party Network Management System with Digivance CXD/NXD

Digivance CXD/NXD 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/NXD 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/NXD 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.
  - 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.
- **Note:** The CXD/NXD Element Manager System (EMS) may be used to control and monitor the system.

### 3.7 Configuring the Hubmaster Node

A correctly configured Hubmaster Node is required to operate a Digivance CXD/NXD network. To simplify this task, the Digivance CXD/NXD 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 Hubmaster has the following responsibilities:

- Network Timing Protocol Daemon (/usr/sbin/ntpd), synchronous with GPS input.
- Dynamic Host Configuration Protocol (DHCP) 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/NXD Tenant processing (/usr/bin/tenantscan and /usr/bin/tenant).

#### 3.7.1 Using the Configure-Hubmaster Script

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

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

##### 3.7.1.1 IP Address / Netmask

At the IP prompt, enter the static IP address that has been assigned to this Hubmaster 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/NXD DHCP settings. The netmask prompt further defines which subnet the Hubmaster 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/NXD system.



### 3.7.1.2 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.

### 3.7.1.3 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 Hubmaster node itself. Failure to enter a valid IP address in this field will result in the improper network operation of the Digivance CXD/NXD System.

### 3.7.1.4 HUBMASTER Domain

Each Hubmaster node requires its own domain to service. This is to allow multiple Hubmaster nodes to use the same upstream DNS, and also negates the problem where slave nodes try to talk to the “wrong” Hubmaster. The default value is Digivance CXD/NXD, 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/NXD, Digivance CXD/NXD-4XD-G22, etc.).

### 3.7.1.5 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 Hubmaster 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 Hubmaster node once the script has been run to ensure that the modifications made via configure-hubmaster are in effect.

### 3.7.1.6 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 Hubmaster will use its current time as the default.

### 3.7.1.7 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 software will convert the SNMP-V2 traps to SNMP-V1 traps before transmitting them.

### **3.7.2 Using Dynamic Host Configuration Protocol With Digivance CXD/NXD**

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

#### **3.7.2.1 Using The Provided Hubmaster DHCP**

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

#### **3.7.2.2 Incorporating Existing LAN DHCP**

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

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

As the Hubmaster 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 Hubmaster 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 Hubmaster to be IP 172.20.88.3.

It is also important to have a mechanism in place to update the LAN DNS with the Hubmaster IP address, so that the Digivance CXD/NXD nodes know where to send data. Since the Hubmaster 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 Hubmaster DHCP server be utilized instead.

### **3.7.2.3 Using Domain Name Service With Digivance CXD/NXD**

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/NXD Hubmaster node comes standard with a DNS which services its related subnet. In addition, the Hubmaster node can employ DNS forwarding to utilize a pre-existing LAN DNS. The following sections outline the steps necessary to use the Digivance CXD/NXD DNS.

### **3.7.2.4 Using The HUBMASTER DNS**

The Digivance CXD/NXD DNS is automatically updated via NIPR/S 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.

### **3.7.2.5 Incorporating Existing LAN DNS**

The method of incorporating an existing LAN DNS begins with configuring the Hubmaster 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 Hubmaster 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.

## **3.8 Configuring the “Slave” and RAN Nodes**

The Digivance CXD/NXD system takes care of networking setup for the Hub “Slave” and RAN nodes. Non network setup is shown on the following sections.

### **3.8.1 Managing the Hub Node MIB**

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

#### **3.8.1.1 Site ID**

*transceptHubNodeTable.transceptHubNodeSiteID*

The Site ID designates the physical location of the CXD/NXD 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 CXD/NXD Hub. GPS coordinates or road names also work well. The Site ID can be up to 64 characters long.

### **3.8.1.2 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.

### **3.8.1.3 CPU Chassis ID**

*transceptHubNodeTable.transceptHubNodeCPUChassisID*

Any chassis in a rack needs 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.

### **3.8.1.4 Hostname**

*transceptHubNodeTable.transceptHubNodeHostname*

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

### **3.8.1.5 IP Address**

*transceptHubNodeTable.transceptHubNodeIPAddress*

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

### **3.8.1.6 Clean**

*transceptHubNodeTable.transceptHubNodeClean*

The Hub Node MIB contains a history of any Digivance CXD/NXD CPU ever seen by the Hubmaster. 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. 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.

### 3.8.1.7 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.

### 3.8.1.8 Setting The GPS Coordinates (Hubmaster 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 Hubmaster node in the Digivance CXD/NXD system contains a GPS receiver, these MIB fields will not be used for Hub Slave nodes. The Digivance CXD/NXD software (Hub Config Process) checks for the presence of a GPS on the Hubmaster node - if the GPS is present, then the GPS longitude/latitude values will be automatically populated from the Hubmaster Network Node MIB. If the GPS is not present, then the manually entered values will be pushed to the Network Node MIB of the Hubmaster 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.

## 3.8.2 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 Hubmaster node. It is comprised of the following elements:

### 3.8.2.1 IP Address

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

### 3.8.2.2 Hostname

*transceptRanNodeTable.transceptRanNodeHostname*

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

### 3.8.2.3 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.

► **Note:** For tenant information propagation to occur, this field must be populated.

### 3.8.2.4 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.

► **Note:** For tenant information propagation to occur, this field must be populated.

### 3.8.2.5 RucXPaY Connection

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

These entries manually record the RF connection path between the RAN UpConverter's RFA outputs and the antenna.

For example, if the RFA attached to RUC A1's "1/3" output is connected to a PCS ADB RFA, then *transceptRanNodeTable.transceptRanNodeRuc1Pa1Connection* should be set to "pcsADB". This data is best gathered at installation time. Repeat for all RUCs and RFAs as necessary.

The RFA configuration options are pcsA, pcsB, pcsC, pcsD, pcsE, pcsF, smrA, smrB, pcsADB, pcsEFCG, smrA, smrB, cellA, and cellB.

### 3.8.2.6 Multicoupler/LNA Connection

*transceptRanNodeTable.transceptRanNodeRdcZMucOrLnaConnection, Z=1-5*

These entries manually record the RF connection path between the RAN downConverter's outputs and the RFA. For example, if the RFA attached to RDC A2's output is connected to a PCS ADB RFA, then *transceptRanNodeTable.transceptRanNodeRdcZMuOrLnaConnection* should be set to "pcsADB". This data is best gathered at installation time. Repeat for all RUCs and RFAs as necessary.

The Multicoupler/LNA configuration options are pcs, cell, smrA, smrB, cellSMR

### 3.8.2.7 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.

### 3.8.2.8 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 Hubmaster 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. The old node information will be removed. No further action is required. Note that if the node is present and valid, it will reappear within seconds, even if it is cleared.

### 3.8.2.9 RAN Disable

*transceptRanNodeDisableTable.transceptRanNodeDisableRanState*

This entry in the RAN Node MIB allows a given RAN to have all of its PAs disabled(\*). By setting this field to "disabled", the Digivance CXD/NXD software will automatically push the value down to the Network Node MIB on the selected RAN, which will cause all PAs 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

### 3.8.2.10 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. The Digivance CXD/NXD 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 manually entered 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.

## 3.9 BTS Integration

### 3.9.1 BTS Validation

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

### 3.9.2 Path Balancing

This section defines the procedure for balancing the forward and reverse paths for a given Tenant Sector.

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

#### 3.9.2.1 Forward Path Balancing

There are two ways to interface the forward signals into the CXD/NXD Hub, via the BIM or to the FBHDC directly. This section describes the balancing of each.

#### FBHDC Input

A direct input to the FBHDC is possible when the composite level of the input signals is -4dBm or less and the forward signals are non-duplexed. A block diagram of the forward path balancing components is shown in [Figure 11](#).

- Composite Input Power – Sum of all carriers, no more than -4 dBm.
- PA Output Power – Tenant MIB value used to measure Output of PA.



- RAN Output Power – PA Output Power Minus 2dB diplexer/cable loss.
- RUC Attn Offset – Tenant MIB value used to adjust PA output power to account for variations in RF chain.

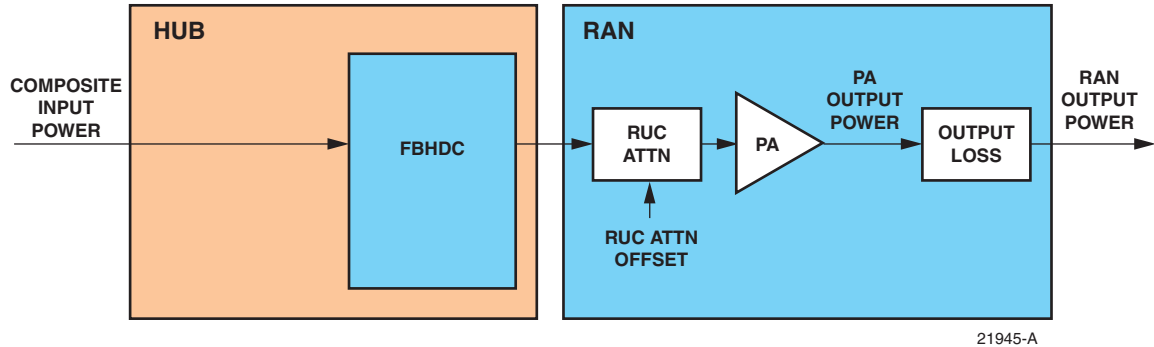


Figure 11. FBHDC Direct Cable Balancing

Table 8 shows the recommended power levels and gains for the various CXD/NXD bands.

Table 8. Forward Setting

BAND	COMPOSITE INPUT POWER	PA OUTPUT POWER	RAN OUTPUT POWER	FORWARD GAIN
SMR-A	-7 dBm	+37 dBm	+35 dBm (CXD) +35.5 dBm (NXD)	+42 dB
SMR-B	-7 dBm	+37 dBm	+35 dBm (CXD) +35.5 dBm (NXD)	+42 dB
Cellular *	-4 dBm	+40dBm	+38 dBm (CXD) +38.5 dBm (NXD)	+42 dB
PCS *	-4 dBm	+43 dBm	+41 dBm (CXD) +41.5 dBm (NXD)	+45 dB

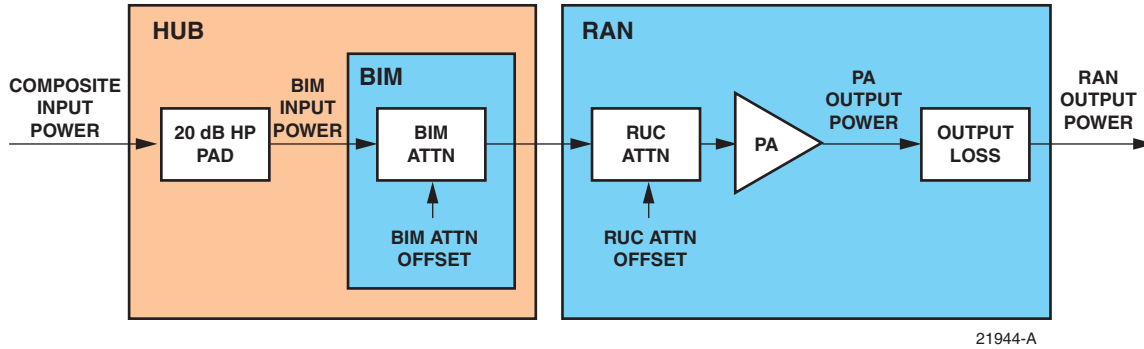
\* Subtract 1 dB when using CDMA signals.

The FBHDC input balancing procedure is as follows:

1. Insert signals into FBHDC at the recommended input level (composite)
2. Using the *transceptTenantCalTable.transceptTenantRanYOutputPower* fields of the Tenant OAM MIB, examine the PA output power for each RAN in the simulcast
3. Using the *transceptTenantGenTwoTable.transceptTenantRucYAttenOffset* field in the Tenant OAM MIB, adjust the RUC attenuator to perform final adjustments with all carriers present. A positive offset lowers the output power and negative offset increases it.

### BIM Input

High Power duplexed interfaces requires the use of the High Power Attenuator and the BIM Module. A block diagram of the forward path balancing components is shown in [Figure 12](#).



**Figure 12. BIM Forward Balance**

- Composite Input Power – Sum of all carriers, no more than 47 dBm
- PA Output Power – Tenant MIB value used to measure Output of PA
- RAN Output Power – PA Output Power Minus diplexer/cable loss (2 dB in CXD, 1.5 dB in NXD)
- RUC Attn Offset – Tenant MIB value used to adjust PA output power to account for variations in RF chain
- BIM Attn Offset – MIB value used to adjust for lower input levels.

[Table 9](#) shows the recommended power levels and gains for the various CXD/NXD bands when interfaced to the 20 dB Attenuator and the BIM.

**Table 9. Recommended Forward Balance**

BAND	COMPOSITE INPUT LEVEL	PA OUTPUT POWER	RAN OUTPUT POWER	FORWARD GAIN
SMR-A	44 dBm	+37 dBm	+35 dBm (CXD) +35.5 dBm (NXD)	-9 dB
SMR-B	44 dBm	+37 dBm	+35 dBm (CXD) +35.5 dBm (NXD)	-9 dB
Cellular *	47 dBm	+40dBm	+38 dBm (CXD) +38.5 dBm (NXD)	-9 dB
PCS *	47 dBm	+43 dBm	+41 dBm (CXD) +41.5 dBm (NXD)	-6 dB

\* Subtract 1 dB when using CDMA signals.

The BIM input balancing procedure is as follows:

1. Insert signals into the HP Attenuator at the recommended input level (composite).
2. If the input level is lower than the recommended value, adjust the *transceptTenantMoreAttenTable.transceptTenantBimForwardAttenZOffset* fields in the Tenant OAM MIB by a comparable amount.

► **Note:** For example: If the PCS composite input is 44 dBm, enter a -30 into the *transceptTenantMoreAttenTable.transceptTenantBimForwardAttenZOffset* field.

The BIM input balancing procedure is as follows:

1. Insert signals into the HP Attenuator at the recommended input level (composite).
2. If the input level is lower than the recommended value, adjust the *transceptTenantMoreAttenTable.transceptTenantBimForwardAttenZOffset* fields in the Tenant OAM MIB by a comparable amount.

For example: If the PCS composite input is 44 dBm, enter a -30 into the *transceptTenantMoreAttenTable.transceptTenantBimForwardAttenZOffset* field.

3. Using the *transceptTenantCalTable.transceptTenantRanYOutputPower* fields of the Tenant OAM MIB, examine the PA output power for each RAN in the simulcast
4. Using the *transceptTenantGenTwoTable.transceptTenantRucYAttenOffset* field in the Tenant OAM MIB, adjust the RUC attenuator to perform final adjustments with all carriers present.

### 3.9.3 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). The reverse gain settings are shown in [Table 10](#).

**Table 10. Reverse Gain Settings**

REVERSE GAIN (DB)	COMMENT
+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/NXD coverage

Use the following procedure to balance the reverse path:

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.

► **Note:** The +/- 10 dB reverse gain setting assumes a 20 dB attenuator. Without the attenuator, the gain is +10 to +30 dB.

### 3.9.4 Functional RAN Call Verification

At the completion of BTS integration, it is recommended that the coverage area be driven to insure all RANs are operational. The following procedure is recommended:

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

## 4 OTHER SYSTEM TASKS

This section contains descriptions and directions for system tasks that may need to be performed at some future time after a system is installed and configured.

### 4.1 Updating System Software

The ADC software upgrade process is based on packaging utilities built into the Linux-based operating system used by ADC.

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-3.4.0-upgrade* would be used to upgrade a target Hub or RAN CPU to a new software version 3.4.0. When invoked, the upgrade executable will automatically take the appropriate actions to upgrade the target CPU.

#### 4.1.1 Release Notes

The release notes delivered with each software release distribution contain specific details about the changes being made in that software release. The release notes itemize each change made and include a description of the problem or issue being addressed, a description of how the problem or 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. Also included are the steps needed to complete the upgrade.

## 4.2 Upgrading an Existing System

The most common upgrade scenario is one where an existing, fielded, operational system is having all of its CPUs upgraded to the next version of software.

### 4.2.1 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 `transceptOpencellPathtraceTable` 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.

### 4.2.2 Upgrade Steps

The upgrade steps are found in the Release Notes for that software version release.

### 4.2.3 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 3.2) and entering the following:

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

<i>/usr/bin/pathtrace</i>	<i>/usr/bin/rgc</i>
<i>/usr/bin/nodepaths</i>	<i>/usr/bin/equipment</i>
<i>/usr/bin/netnode</i>	<i>/usr/bin/stf</i>
<i>/usr/bin/hlpwatch</i>	<i>/usr/bin/i2cbusscan</i>
<i>/usr/bin/pcibusscan</i>	<i>/usr/bin/i2cbusmaster (6 instances)</i>
<i>/usr/bin/fgc</i>	<i>/usr/bin/gps</i>
<i>/usr/bin/niprs (4 instances)</i>	<i>/usr/bin/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 ID's 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.

#### 4.2.4 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-3.0.0-downgrade* would be used to revert a CPU that has been upgraded to version 3.1.0 back to 3.0.0.

Note that it is difficult to guarantee that a CPU reverted to its previous revision will work exactly as the CPU did prior to the upgrade. There are simply too many variables to guarantee this. The regression test cycle here at ADC will include a series of steps to validate that the uninsulated/downgrade process works, but it is extremely difficult to guarantee that all possible failure paths will be exercised.

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.

#### 4.2.5 FPGA Updates

Certain software releases will contain updates to the FPGA images that the ADC modules load on startup. These FPGA image updates need to be programmed into an EEPROM on the module(s) in question. The ADC software processes, upon detection of an out of date FPGA image, will notify the maintainer via an ADC trap.

The maintainer is responsible for programming the EEPROM at the earliest convenience (See Reference #80-83 in Section 4). Depending on the module(s) being updated with new FPGA images, this action could take as long as 20-30 minutes to complete



**Caution:** *While FGPA's are being downloaded, service will be interrupted.*

### 4.2.6 FIC Software Upgrade

Use this procedure to upgrade the software on the FIC compact flash card.

1. FTP the upgrade.tar file to /tmp on the FIC.
2. ssh to the FIC using the “root” login.
3. cd to the /tmp directory and untar the upgrade.tar file.
4. If needed, shut down the running software on the FIC using the command:  

```
/etc/init.d/digivance stop
```
5. Overwrite the current software with the files that were untarred using the commands:  

```
cd upgrade  
cp -r * /
```
6. If needed, restart the software using the command:  

```
etc/init.d/digivance start
```
7. Update the backup file system on the compact flash, as follows:
  - a. Run the command “cat /proc/cmdline” to determine if /xsysace/disc0/part1 or if /xsysace/disc0/part2 is being used by the Linux kernel.
    - If part1, then mount the backup partition using the command:  

```
mount /mnt/part3
```
    - If part2, mount the partition using the command:  

```
mount /mnt/part2
```
  - b. Overwrite the software on the backup partition using the untarred files with the command:  

```
cp -r * /mnt/part?
```
  - c. Unmount the backup partition using the command:  

```
umount /mnt/part?
```
8. Remove the upgrade files using the commands:  

```
cd /tmp; rm -rf upgrade upgrade.tar
```

## 4.3 Backup/Restore

There are several files on a hubmaster 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:

#### 4.3.1 Backup

1. Telnet to the target hubmaster CPU, using operator/operate as the username/password
2. Run the backup script:

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

#### 4.3.2 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.

1. Telnet to the target hubmaster CPU, using operator/operate as the username/password
2. Run the restore script:

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

3. Reboot by entering: *sudo reboot*

► **Note:** The restore script is simply the backup script invoked with a “-r” switch. The “-r” switch is identical to the switch “--restore”.

## 4.4 Adding/Removing SNMP Traps

SNMP traps are sent automatically by the ADC system to all managers named “trap-sink” in DNS.

To add an entry to DNS, use the nsupdate (sudo nsupdate) command on the hubmaster. The application nsupdate will prompt for an input, (>) at which point enter:

```
update add version-trap-sink.domain 3600 A address
```

Note that:

- **version** should be either “v1” or “v2”, depending on whether you want SNMP version 1 traps or version 2 notifications to be sent to the sink, respectively.
- **address** should be the IP address of a trap-sink (an SNMP manager that can receive traps); there can be any number of trap-sinks – simply enter one line per trap sink.
- **domain** is that of the ADC system subnet on which nsupdate is being run.

After completing the desired number of lines, finish by entering two *blank* lines and then a *Ctrl-D*.

To remove a trap-sink, do as above except at the prompt for input ('>'), enter:

```
update delete version-trap-sink.domain A address
```

## 4.5 Updating Spare CPUs

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:

- Each digital chassis in the Hub supports two CPUs - it is possible that one of the installed Hub digital chassis is only half-populated and contains an available CPU slot. This note is only applicable to Generation 1 Hubs, since Generation 2 Hub chassis only contain one CPU.
- 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 CPUs 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 CPUs 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 ADC software release is of a new major revision, spare CPUs in stock need to be upgraded at the same time as all of the other CPUs 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 chaos 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.



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

## 4.6 MIB Extraction

MIB extraction is 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/transept/***
- Extract/get all of the MIB text files located there by entering: ***mget TRANSCEPT-\*.txt***, answering yes to each prompt.
- Extracting the MIBs in this fashion will ensure that the correct and compatible versions of all of MIBs are compiled into the NMS.
- Alternatively, the MIBs 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 ADC MIBs directory by entering: ***cd /usr/share/mibs/***
- Bundle and zip all the MIBs into a tarball and extract them by entering: ***get transept.tar.gz***.

## 4.7 Gain Management and Fault Detection

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

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

### 4.7.1 Forward Gain Management

The Digivance CXD/NXD system has a compensation feature in the forward path to account for changes in gain as a function of temperature. This feature applies on a per RAN basis and is enabled by default. The operator can disable this feature if desired.

### 4.7.2 Reverse Automatic Gain Control

The Digivance CXD/NXD system autolimits any strong in-band signal which reaches the RAN at a peak input level of greater than -38 dBm relative to the antenna port. The process does this by monitoring A/D overflows and adding attenuation in the RDC when these overflow occur. “AGC events” are logged on the CPU running the RDC process. Attenuation is backed out as the signal strength subsides.

### 4.7.3 Forward Delay Management

Forward Delay Management (FDM) is a software function that is part of Tenant Processing and whose responsibility is to equalize the path delays to all RANs in a simulcast group. The FDM process is “enabled” in the Tenant OAM MIB (see Section 3, Sub-Section 7 Tenant Configuration).

### 4.7.4 Reverse Delay Management

Reverse Delay Management (RDM) is a software function that is part of Tenant Processing and whose responsibility is to equalize the path delays to all RANs in a simulcast group. The RDM process is “enabled” in the Tenant OAM MIB (see Section 3, Sub-Section 7 Tenant Configuration).

### 4.7.5 Forward Continuity

Forward Continuity Management (FCM) is a software function that may be used to verify that the forward RF paths are functioning properly and are able to pass signals. This function is disabled by default.

### 4.7.6 Reverse Continuity

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

The various parts of RCM are defined in the sections that follow.

#### 4.7.6.1 Noise Test

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:

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

#### 4.7.6.2 RAN Down Converter (RDC) Tone Test

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.

### 4.7.6.3 Hub Up Converter (HUC) Tone Test

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  $-70$  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 “SNMP Agent and Fault Isolation Guide” for details.

### 4.7.7 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.

The limits are set to 1 dB above the rated output for a given Power Amplifier. For 10 watt PAs (40 dBm), the limit is 41 dBm. For 20 watt PAs (43 dBm), the limit is 44 dBm.

See the “SNMP Agent and Fault Isolation Guide” guide for details.

#### 4.7.8 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 (-3.5 dBFS), 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 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 the “SNMP Agent and Fault Isolation Guide” guide for details.

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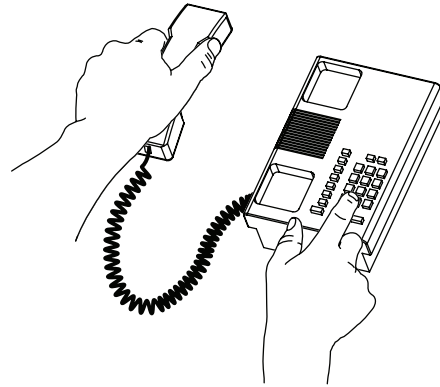
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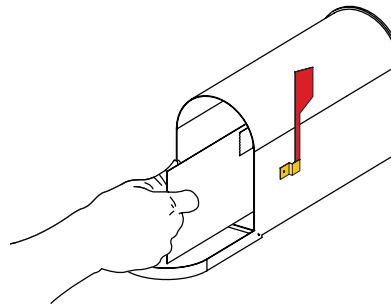


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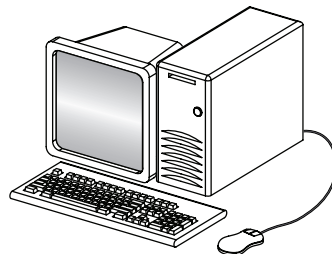
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