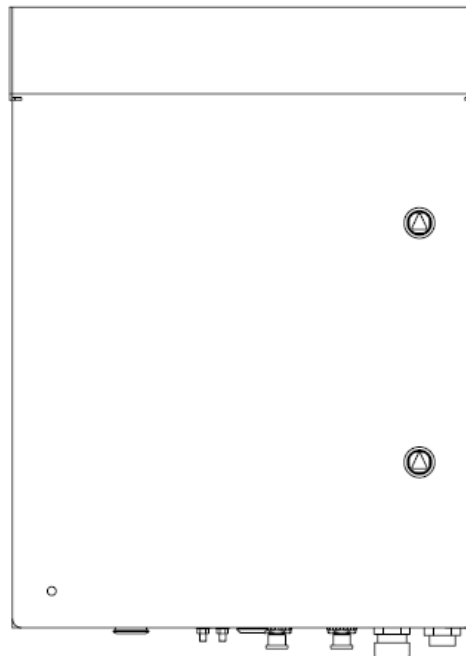
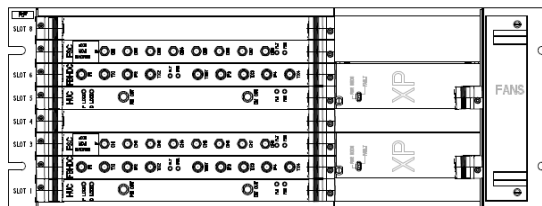
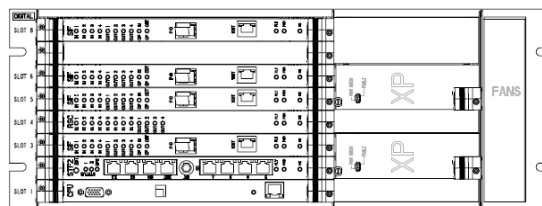




Digivance® CXD Multi-Band Distributed Antenna System Operation Manual





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LIST OF CHANGES

The technical changes incorporated into this issue are listed below.

SECTION	IDENTIFIER	DESCRIPTION OF CHANGE
-	-	Original release

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ABOUT THIS MANUAL

This Operation Manual provides the following information:

- An overview of the Digivance CXD system.
- A description of the basic system components including the Digital Chassis, RF Chassis, RAN, CPU, STF2, FBHDC, HUC, SIF, FSC, RSC, RDC, RUC, APEC, DPEC, cPCI Power Supplies, and RFA.
- Procedures for turning-up the system and verifying that the system is functioning properly.
- Procedures for maintaining the system including troubleshooting problems and replacing faulty components.
- Product warranty, repair, return, and replacement information.

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

RELATED PUBLICATIONS

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

Title/Description	ADCP Number
Digivance CXD/NXD Hub Installation and Maintenance Manual Provides instructions for installing and maintaining the Digivance CXD Hub equipment.	75-193
Digivance CXD Radio Access Node Installation and Maintenance Manual Provides instructions for installing and maintaining the Digivance CXD Radio Access Node (RAN).	75-194
Digivance CXD/NXD SNMP Agent and Fault Isolation User Guide Provides instructions for using the Digivance SNMP Agent to control and monitor the system and software and troubleshooting system performance.	75-195
Digivance CXD /NXD Element Management System User Manual Provides instructions for using the Digivance EMS to control and monitor the system and software and troubleshooting system performance.	75-199

ADMONISHMENTS

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



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



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



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

GENERAL SAFETY PRECAUTIONS



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



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



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



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



Caution *This system is a RF Transmitter and continuously emits RF energy. Maintain 3 foot minimum clearance from the antenna while the system is operating. Wherever possible, shut down the RAN before servicing the antenna.*



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



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



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

SAFE WORKING DISTANCES

The Digivance CXD, when connected to an antenna, radiates radio frequency energy. To comply with Maximum Permissible Exposure (MPE) requirements, the maximum composite output from the antenna cannot exceed 1000 Watts EIRP and the antenna must be permanently installed in a fixed location that provides at least 6 meters (20 feet) of clearance.

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.

COMPLIANCE STATEMENT

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

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

The Digivance CXD Hub has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

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

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

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

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

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

Wind Loading: The CXD RAN is able to withstand wind loads up to 150 mph.

ACRONYMS AND ABBREVIATIONS

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

AC	Alternating Current
ANT	Multi-band Antenna
APEC	AC Power Entry Card
AWG	American Wire Gauge
BER	Bit Error Rate
BIM	Base Station Interface Module
BTS	Base Transceiver Station
C	Centigrade
CD-ROM	Compact Disk Read Only Memory
COM	Common
CPU	Central Processing Unit
DAS	Distributed Antenna System
DC	Direct Current
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Service
DPEC	DC Power Entry Card
EIA	Electronic Industries Association
EMS	Element Management System
ESD	Electrostatic Discharge
F	Fahrenheit
FBHDC	Full Band Hub Down Converter
FCC	Federal Communications Commission
FDA	Food and Drug Administration
FSC	Forward Simulcast Card

GUI	Graphical User Interface
HCP	Hardware Control Process
HLP	High Level Process
HRM	Hub Reference Module
HUC	Hub Up Converter
IEL	Injection/Extraction Locking
LED	Light Emitting Diode
MHz	Mega Hertz
MPE	Maximum Permissible Exposure
NIPR/S	Network IP Receiver/Sender
NMS	Network Management System
NOC	Network Operations Center
Node	Any CPU in the Digivance CXD system
PA	Power Amplifier
PC	Personal Computer
PCS	Personal Communications System
PDU	Power Distribution Unit
PPS	Pulse Per Second
RAN	RAN, Tenant 1 – 3
RDC	RAN Down Converter
RF	Radio Frequency
RMA	Return Material Authorization
RSC	Reverse Simulcast Card
RUC	RAN Up Converter (Dual)
RX	Receive or Receiver
SIF	Synchronous Interface (Fiber Interface also referred to as WBOT)
SMR	Specialized Mobile Radio
STF	System Interface
TX	Transmit or Transmitter
UL	Underwriters Laboratories
VAC	Volts Alternating Current
VDC	Volts Direct Current
VSWR	Voltage Standing Wave Ratio
WECO	Western Electric Company
WDM	Wave Division Multiplexer

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SECTION 1: OVERVIEW

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1 INTRODUCTION

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

2 DIGIVANCE CXD SYSTEM OVERVIEW

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

2.1 Basic Components

Figure 1-1 illustrates a Digivance system with RAN's distributed over a desired geographical area, connected back to a Wireless Service Provider (WSP) base station(s) at a Hub locale. The illustration shows a dual-band SMR A and SMR B configuration with variable digital simulcasting as a reference. The Digivance CXD Hub equipment consists of a rack assembly containing RF Chassis and Digital Chassis equipment, high power attenuators, base station interface modules, power distribution unit, Ethernet hub, Hub Reference Module and other material sufficient to provide the interconnection at the RF layer between the base station electronics and the Digivance CXD RAN's located in the field.

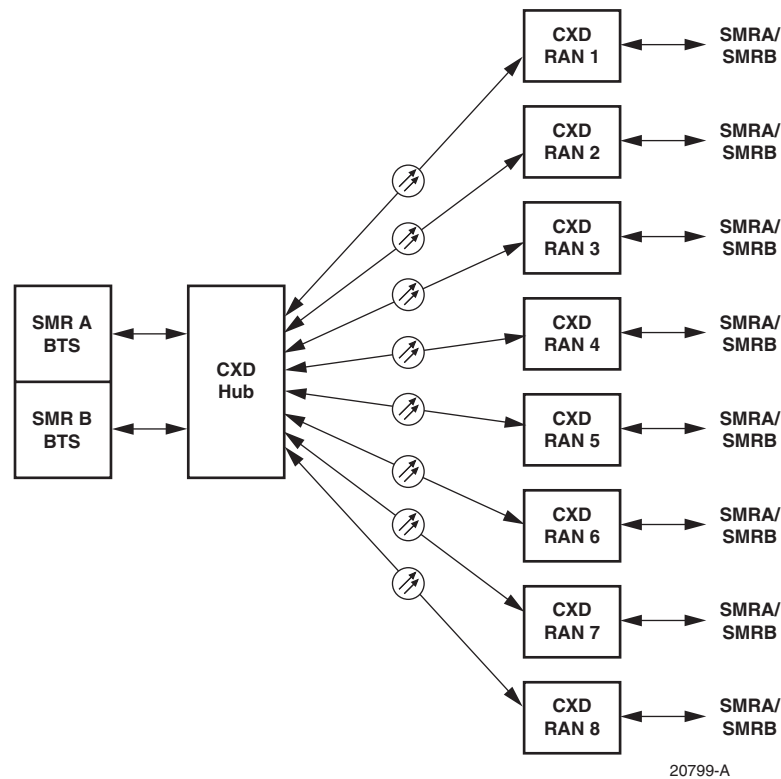


Figure 1-1. Digivance CXD Architectural Summary Diagram

2.2 General Description

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

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

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

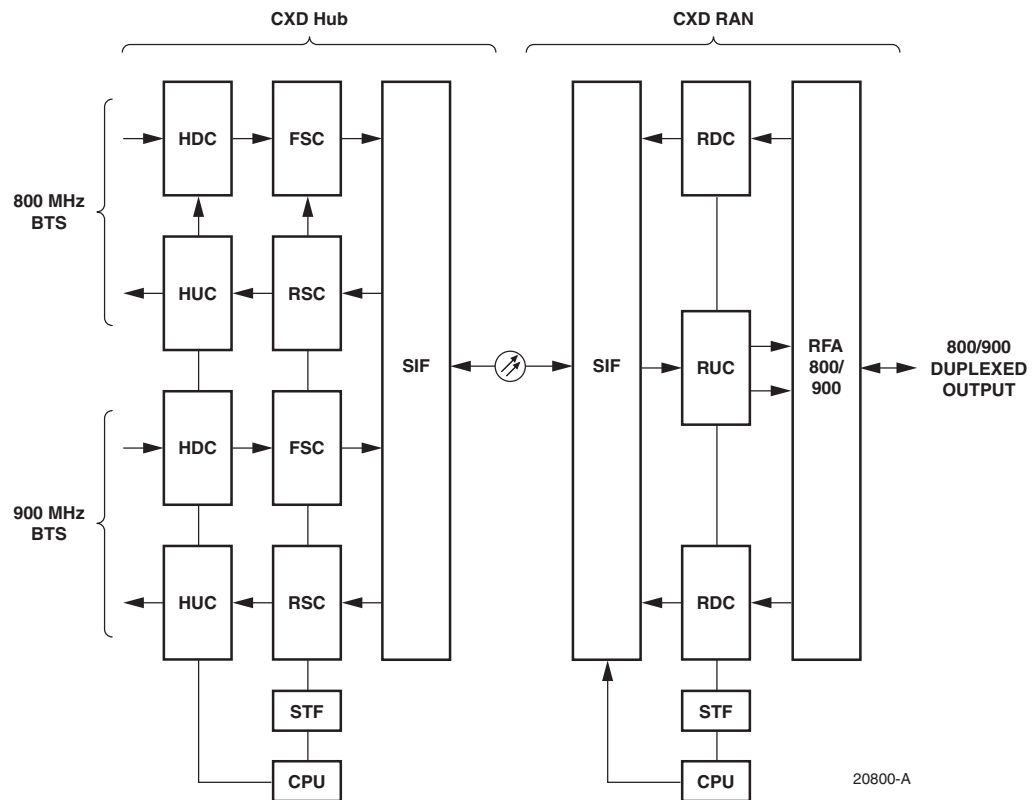


Figure 1-2. Digivance CXD Block Diagram

2.3 Local Service Interface

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

The Digivance CXD Element Management System is a Web based system that provides the various control and monitoring functions required for local management of each CXD system. The user interface into the EMS is a PC-type laptop computer loaded with a standard Web browser. The EMS is 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.

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

2.4 Remote NOC Interface

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

3 SYSTEM FUNCTIONS AND FEATURES

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

3.1 Fiber Optic Transport

The optical signal of a Digivance CXD is digital. The input and output RF signal levels at the Hub SIF or the RAN SIF are not dependent on the level of the optical signal or the length of the optical fiber. The maximum length of the optical fibers is dependent on the loss specifications of the optical fiber and the losses imposed by the various connectors and splices. The system provides an optical budget of **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.

3.2 Control and Monitoring Software

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

3.3 Fault Detection and Alarm Reporting

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

3.4 Powering

The Hub Digital and RF Chassis are powered by -48 Vdc and must be hard-wired to a local office battery power source through a fuse panel. The power consumption of the system will depend on the configuration of the system and how the Digital Chassis and RF Chassis are populated.

Table 1-1 lists the typical power consumption of the respective modules for the Digital Chassis.

Table 1-1. Digital Chassis Power Consumption

MODULE	POWER
Digital Chassis	76.0 Watts
CPU	20.5 Watts
STF2	3.5 Watts
SIF	15.5 Watts
RSC	9.0 Watts

For a standard configuration of 4:1 simulcasting, Table 1-2 lists the estimated power consumption for the Digital Chassis

Table 1-2. Digital Chassis 4:1 Simulcast Power Consumption

MODULE	# OF MODULES	POWER
Digital Chassis	1	76.0 Watts
CPU	1	20.5 Watts
STF2	1	3.5 Watts
SIF	4	15.5 Watts
RSC	1	9.0 Watts
	Total Power	170 Watts

Table 1-3 lists the typical power consumption of the respective modules for the RF Chassis.

Table 1-3. Digital Chassis Power Consumption

MODULE	POWER
RF Chassis	55.0 Watts
FBHDC	11.0 Watts
HUC	8.0 Watts
FSC	13.5 Watts

For a single-band configuration, Table 1-4 lists the estimated power consumption for the RF Chassis

Table 1-4. RF Chassis Single-band Power Consumption

MODULE	# OF MODULES	POWER
RF Chassis	1	55.0 Watts
FBHDC	1	11.0 Watts
HUC	1	8.0 Watts
FSC	1	13.5 Watts
	Total Power	87.5 Watts

For a dual-band configuration Table 1-5 lists the estimated power consumption for the RF Chassis

Table 1-5. RF Chassis Single-band Power Consumption

MODULE	# OF MODULES	POWER
RF Chassis	1	55.0 Watts
FBHDC	2	11.0 Watts
HUC	2	8.0 Watts
FSC	2	13.5 Watts
	Total Power	120.0 Watts

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

3.4.1 HUB Power On/Off

Power to the Hub rack is provided using a power system supplied by the customer located in the Hub shelter. Power to the Hub must be supplied through a fuse panel such as the 20 position ADC PowerWorx power distribution panel (available separately). The power circuit for each active element of the system must be protected with a 5 Amp GMT fuse.

Hub Power On

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

Hub Power Off

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

Hub CompactPCI Chassis (RF & Digital) Power On

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

Hub CompactPCI Chassis (RF & Digital) Power Off

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

3.4.2 RAN Power on/off (APEC)

RAN Equipment Power On

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

RAN Equipment Power Off (APEC)

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

3.4.3 RAN Power on/off (DPEC)

RAN Equipment Power On

- Plug the AC line cord into the receptacle located on all RFA's
- Turn power on at the customer supplied load center located on the utility pole

RAN Equipment Power Off (APEC)

- Turn the circuit breaker off at the customer supplied load center located on the utility pole
- Push battery disconnect switch (DISCON) on DPEC front panel
- Wait for all DPEC LEDs to go out
- Unplug the AC line cord from the receptacle located between the cPCI power supplies

3.5 Equipment Mounting and Configuration

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

3.6 HUB Subsystem Assemblies

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

1. The Digital Chassis houses the following modules:
 - CPU (Hubmaster or Slave)
 - System Interface card (STF2)
 - Sonet Interface (SIF)
 - Reverse Simulcast card (RSC)
 - CompactPCI Power Supply (CPS)
 - Fan assembly
2. The RF Chassis houses the following modules:
 - Full Band Hub Down Converter card (FBHDC)
 - Hub Up Converter card (HUC)
 - Forward Simulcast card (FSC)
 - CompactPCI Power Supply (cPCI P/S)
 - Fan assembly
3. Attenuator Rack which houses up to twelve (12) attenuators.

4. Base Station Interface Module (BIM). The BIM is a multi-port transition module used to interface with the Tenant's base station sector. The BIM accepts either duplexed or non-duplexed RF from the base station sector and provides the Digivance CXD-Hub RF section separate transmit and receive paths.
5. Ethernet hub with twenty four (24) ports.
6. -48 VDC Power Distribution Unit.
7. Hub Reference Module (HRM).

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

3.6.1 Digital CompactPCI Chassis & Backplane

The CompactPCI Digital Chassis houses cooling fans, the CPU, System Interface (STF2) module, Sonet Interface (SIF) module, Reverse Simulcast Card (RSC), and power supplies. The backplane provides the distribution for clock, communication, control data and timing.

3.6.2 RF CompactPCI Chassis & Backplane

The CompactPCI RF Chassis houses the cooling fans, RF transceiver modules, Hub Up Converter (HUC), Hub Down Converter (FBHDC), Forward Simulcast card (FSC) and the power supplies. The backplane provides the distribution for clock, communication and control data and timing. RF and digital RF signals are interconnected between modules using the appropriate cabling.

3.6.3 Central Processing Unit (CPU)

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

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

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

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

3.6.4 System Interface (STF2)

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

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

3.6.5 Sonet Interface (SIF)

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

1. Digitized RF Signal information.
2. 10BaseT Ethernet for command and control between Hub and the RAN's.
3. Measures fiber delay used in Delay Management.

3.6.6 Full Band Hub Down Converter (FBHDC)

The Full Band Hub Down Converter (FBHDC) down converts the forward RF carrier to an intermediate frequency (IF) that is then digitized by the Forward Simulcast Card (FSC). Each FBHDC can support up to 15 MHz of contiguous spectrum.

3.6.7 Forward Simulcast Card (FSC)

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

3.6.8 Reverse Simulcast Card (RSC)

The RSC sums the Digital IF (DIF) from up to four (4) RANs into DIF signals that are sent to the appropriate HUC for up conversion to RF. Single and dual-branch diversity are supported.

3.6.9 Hub Up Converter (HUC)

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

3.6.10 Base Station Interface Module (BIM)

The BIM provides the following BTS interface functions:

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

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

3.6.11 Hub Reference Module (HRM)

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

3.6.12 Ethernet Hub

Each Hub rack is equipped with a 24 port Ethernet Hub. It is powered by 120 VAC, or optional –48 VDC can be chosen. The Ethernet Hub is used to connect RAN CPUs (through Hub SIFs) and Hub CPUs to an existing LAN/WAN and to each other.

3.7 RAN Subsystem Assemblies

The RAN consists of a cabinet, RAN Chassis and Backplane, a Central Processing Unit (CPU), a System Interface (STF2), a Sonet Interface (SIF), RAN Down Converter (RDC or RDC2), RAN Up Converter (RUC2.X or RUC3), AC Power Entry Card (APEC) or DC Power Entry Card (DPEC); and the RF Assembly consisting of Power Amplifiers, duplexers, and RFA interface controller. There are two cabinet options: the Standard CXD RAN Cabinet and the Extended CXD RAN Cabinet. The standard cabinet supports two Radio Frequency Assemblies (RFA) with no battery backup; or one RFA and one internal battery backup assembly. The extended cabinet supports two RFA's and an extended battery backup assembly housed in a battery compartment located on the side of the cabinet.

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

3.7.1 Central Processing Unit (CPU)

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

1. Manages all RAN hardware including RF and Digital equipment
2. Manages gain & delays
3. Monitors signal presence and quality
4. Ethernet interconnect
5. Generates SNMP traps based upon fault conditions

3.7.2 System Interface (STF2)

The STF2 module provides the ability to communicate between the CPU and other modules (RDC, RUC, RFA interface controller) using four I2C busses. The STF2 also contains the GPS module.

3.7.3 Sonet Interface (SIF)

The SIF module provides the optical interface between the Hub and RAN's. The SIF has an optical transceiver module installed that provides the optical transmit and receive functions. The SIF has also the following functions:

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

3.7.4 Small Form-Factor Pluggable (SFP) Optical Transceiver

The Small Form-factor Pluggable (SFP) optical transceiver module provides the optical interface between the Hub equipment and the RAN hardware. The SFP has a laser transmitter and optical receive detector. The Digivance CXD uses industry standard SFP optics which offers a number of configuration options depending on the requirements of the project. The SFP modules are available separately and may or may not be initially installed in the SIF depending on the configuration ordered.

3.7.5 RAN Down Converter (RDC or RDC2)

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

3.7.6 RAN Up Converter (RUC2.X or RUC3)

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

3.7.7 RAN Chassis & Backplane

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

3.7.8 AC Power Entry Card (APEC)

The APEC distributes AC power to the cPCI power supplies in the RAN. Its input range is 100 to 240 VAC. It has a built in EMI filter and fuse holder and provides an access point for fan monitoring and control.

3.7.9 DC Power Entry Card (DPEC)

The DPEC is used to distribute DC power to the cPCI power supplies in the RAN when supporting battery backup. It has a built in EMI filter and fuse holder and provides an access point for fan monitoring and control.

3.7.10 CompactPCI RAN Power Supply (cPCI P/S)

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

3.7.11 RF Assembly

The RF Assembly (RFA) consists of the power amplifier (PA), power supply, fans, duplexers and RFA interface controller. RF assemblies are PCS, Cellular and SMR 800/900 bands.

3.7.12 Internal Battery backup (BAT1) 1-Hour

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

3.7.13 Extended Internal Battery Backup (BAT2) 2-Hour

The Digivance CXD has an option for an extended internal battery back-up through use of the Extended CXD RAN Cabinet with a separate compartment for the batteries. A cabinet using the extended backup option can support two single- or dual-RFA's and can provide up to two hours of battery backup time.

3.7.14 Antenna (ANT)

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

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

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

3.8 Communication Interfaces

3.8.1 I2C

I2C is a bi-directional serial bus that provides a simple, efficient method of data exchange between devices. It is used for the board level communications protocol.

I2C interfaces are used for communication to the following modules:

1. HUB - FBHDC, FSC, HUC, BIM, and HRM.
2. RAN - RDC, RUC, and RFA.

3.8.2 Network Interface

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

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

3.8.3 SNMP

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

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

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1 INTRODUCTION

This section describes the basic components of the Digivance CXD system including the Hub and Radio Access Node (RAN) equipment. The Hub equipment consists of the Central Processing Unit (CPU), the System Interface (STF2), the Sonet Interface (SIF), the Full Band Hub Down Converter (FBHDC), the Hub Up Converter (HUC), the Forward Simulcast Card (FSC), Reverse Simulcast Card (RSC) and CompactPCI Power Supplies (cPCI P/S). Additional hardware includes the Base Station Interface Module (BIM), Hub Reference Module (HRM), a commercial Ethernet Hub and high power RF attenuators.

The RAN is an assembly that consists of the RAN equipment including the RAN Chassis, CPU, STF2, RAN Down Converter (RDC or RDC2), RAN Up Converter (RUC2.X or RUC3), AC Power Entry Controller (APEC), DC Power Entry Controller (DPEC), cPCI P/S and RF Assembly (RFA).

2 DIGITAL CHASSIS

The Digivance Digital Chassis is a rack-mounted cPCI shelf capable of housing 8 industry standard cPCI circuit card modules. The Digital Chassis houses cooling fans and specific modules designed for use in the Digivance CXD system. The backplane of the Digital Chassis provides for distribution of signals between modules including the reference clock, communications, control and data signals. Modules used in the Digital Chassis include the CPU module, System Interface module (STF2), and up to six Reverse Simulcast Cards (RSCs) or Sonet Interface (SIF) digital modules.

Figure 2-1 shows the empty Digital Chassis. The eight empty slots on the left are used for Digivance CXD Hub modules. The slots on the right are used for housing the cPCI power supplies and cPCI fan assembly.

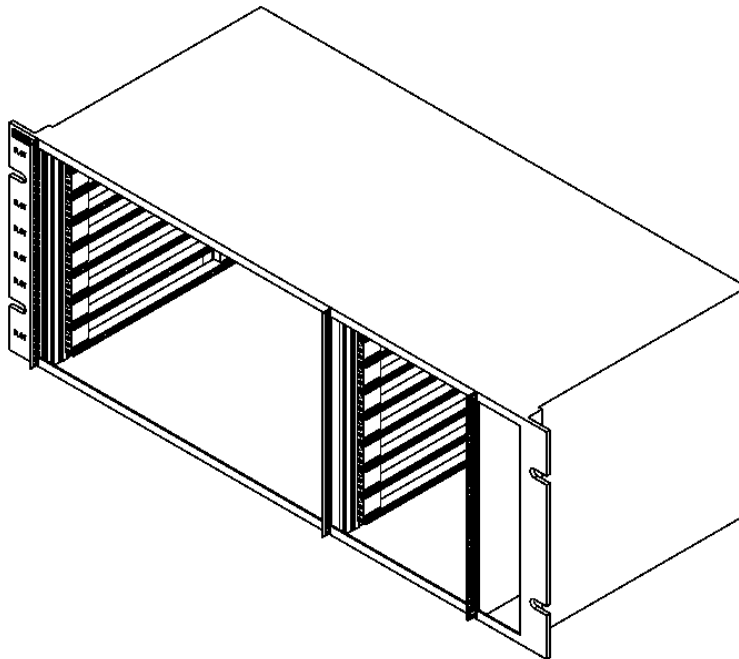


Figure 2-1. Digivance CXD Digital Chassis

Modules and circuit cards are placed into the Digital Chassis and are mated to standard cPCI connectors on the backplane of the chassis. Data and signals are transported over busses on the backplane of the chassis to other modules and ports on the backside of the chassis.

Rear connections are made to the Digital Chassis to connect power, route DIF signals to inputs and outputs of respective modules mounted in the chassis, connect the I2C bus to the chassis, input a 1 Hz reference signal, input a sample clock, input FAN tachometer readings from the RF Chassis, and distribute 12 VDC to other elements of the system. The Digital Chassis also has a Module/Port status indicator that can be used to trace signals through the system and show activity on the ports. Figure 2-2 shows the back panel connections for the Digital Chassis. The references for the back connectors of the Digital Chassis are shown in Table 2-1.

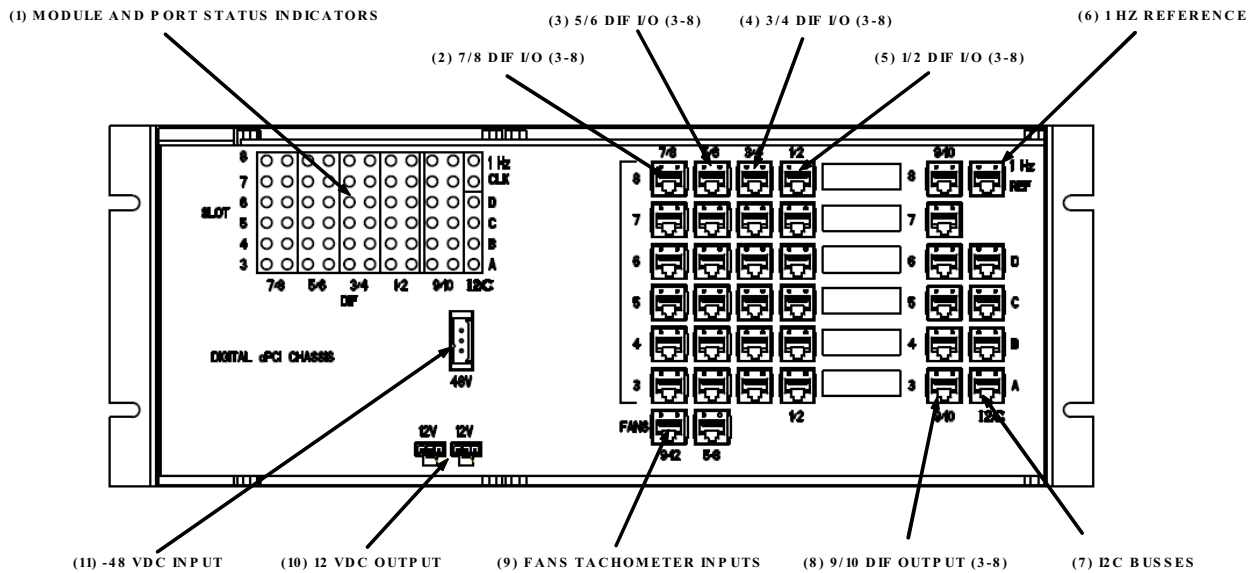


Figure 2-2. Digital Chassis – Rear Connectors

Table 2-1. Digital Chassis References – Rear Connectors

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Slot/DIF	Multi-colored LED	Indicators showing module and port status (see Digital Chassis rear indicators)
2	7/8 DIF I/O	Six RJ-45 Connectors	Output channels 7 & 8 from SIF. Maps to SIFs in Slots 3-8. Input channels 7 & 8 to RSC. Maps to RSCs in Slots 3-8.
3	5/6 DIF I/O	Six RJ-45 Connectors	Outputs channels 5 & 6 from SIF. Maps to SIFs in Slots 3-8. Input channels 5 & 6 to RSC. Maps to RSCs in Slots 3-8.
4	3/4 DIF Input	Six RJ-45 Connectors	Input channels 3 & 4 to SIF/RSC. Maps to SIFs/RSCs in Slots 3-8
5	1/2 DIF Input	Six RJ-45 Connectors	Input channels 1 & 2 to SIF/RSC. Maps to SIFs/RSC in Slots 3-8
6	1Hz/Ref	One RJ-45 connector	1 pulse per second and Reference clock from HRM
7	I2C A-D Busses	Four RJ-45 connectors	I2C comms to RF Chassis, BIMs and HRMs over four busses (A-D)
8	9/10 DIF Output (3-8)	6 RJ-45 connectors	DIF signals from RSC output to HUC in RF Chassis. Maps to RSC in Slots 3-8.
9	FANS	Two RJ-45 connector	Monitors Fans speed of RF Chassis above and below
10	12V	Two 3-pin power output connector	Provides 12V power to BIMs and HRMs
11	-48V	Single 3-pin power input connector	Provides -48VDC to chassis.

The main purpose of the Module/Port status indicators shown in Figure 2-3 is to provide the user instant feedback on the success or failure of a new connection. It also provides path status to aid in troubleshooting missing or degraded connections. The references for the back connectors of the Digital Chassis are shown in the Table 2-2.

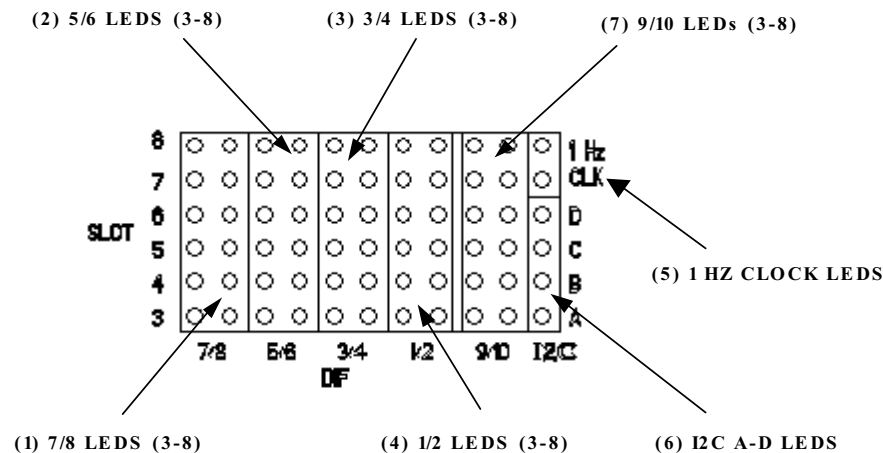


Figure 2-3. Digital Chassis – Rear Indicators

Table 2-2. Digital Chassis References

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	7/8 DIF LEDs (3-8)	12 tri-color LEDs (r/o/g)	SIF/RSC DIF output/input 7 & 8. Green=good, orange=marginal, blinking=clocking issue, red=bad or missing. Maps to Slots 3-8.
2	5/6 DIF LEDs (3-8)	12 tri-color LEDs (r/o/g)	SIF/RSC DIF output/input 5 & 6. Green=good, orange=marginal, blinking=clocking issue, red=bad or missing. Maps to Slots 3-8.
3	3/4 DIF LEDs (3-8)	12 tri-color LEDs (r/o/g)	SIF/RSC DIF input 3 & 4. Green=good, orange=marginal, blinking=clocking issue, red=bad or missing. Maps to Slots 3-8.
4	1/2 DIF LEDs (3-8)	12 tri-color LEDs (r/o/g)	SIF/RSC DIF input 1 & 2. Green=good, orange=marginal, blinking=clocking issue, red=bad or missing. Maps to Slots 3-8.
5	1HZ/CLOCK LEDs	Two green LED	1 Hz blinks once per second. Clock is solid green when reference is present into chassis
6	I2C A-D LEDs	Four green LEDs	Indicates communications activity over the four I2C busses (A-D)
7	9/10 DIF LEDs (3-8)	12 tri-color LEDs (r/o/g)	RSC DIF output. Green=good, orange=marginal, blinking=clocking issue, red=bad or missing. Maps to Slots 3-8.

Figure 2-4 shows an empty Digital Chassis from the front. Slots on the left are numbered from 1 to 8 starting at the bottom of the chassis. Slots on the right of the chassis are used for the cPCI power supplies used to power the chassis and modules and the cPCI fan assembly. Mounting of modules and circuit cards into the Digital Chassis should be done in accordance with Table 2-3.

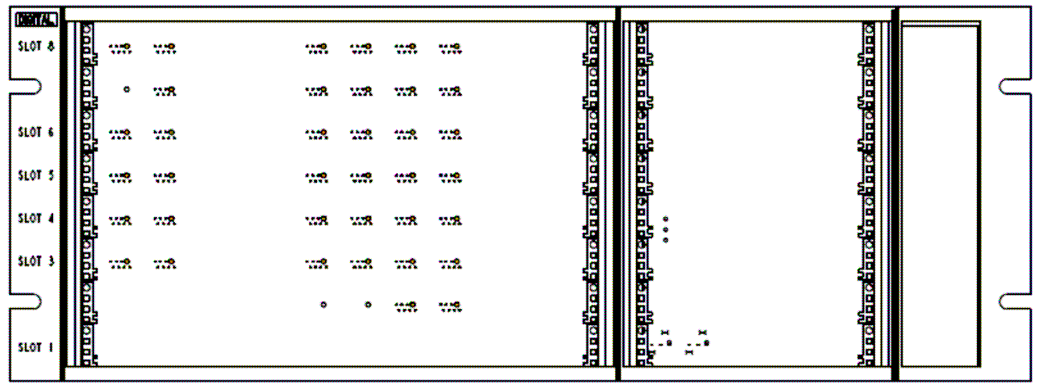


Figure 2-4. Digital Chassis - Front

Table 2-3. Digital Chassis Slot Assignments

SLOT	MODULE
8	SIF or RSC
7	SIF or RSC
6	SIF or RSC
5	SIF or RSC
4	SIF or RSC
3	SIF or RSC
2	STF2
1	CPU

3 RF CHASSIS

The Hub RF Chassis is a rack-mounted chassis capable of housing 8 industry standard cPCI circuit card modules. The RF Chassis houses cooling fans and specific modules designed for use in the Digivance CXD system. The backplane of the RF Chassis provides for distribution of signals between modules including the reference clock, communications, control and data signals. Modules used in the RF Chassis include up to two Full-band Hub Down-Converter (FBHDC) modules, two Forward Simulcast Card (FSC) modules and two Hub Up-Converter (HUC) modules.

Figure 2-5 shows the empty RF Chassis. The eight empty slots on the left are used for Digivance CXD modules. The eight empty slots on the right used for housing the cPCI power supplies which power the modules and the cPCI fan assembly.

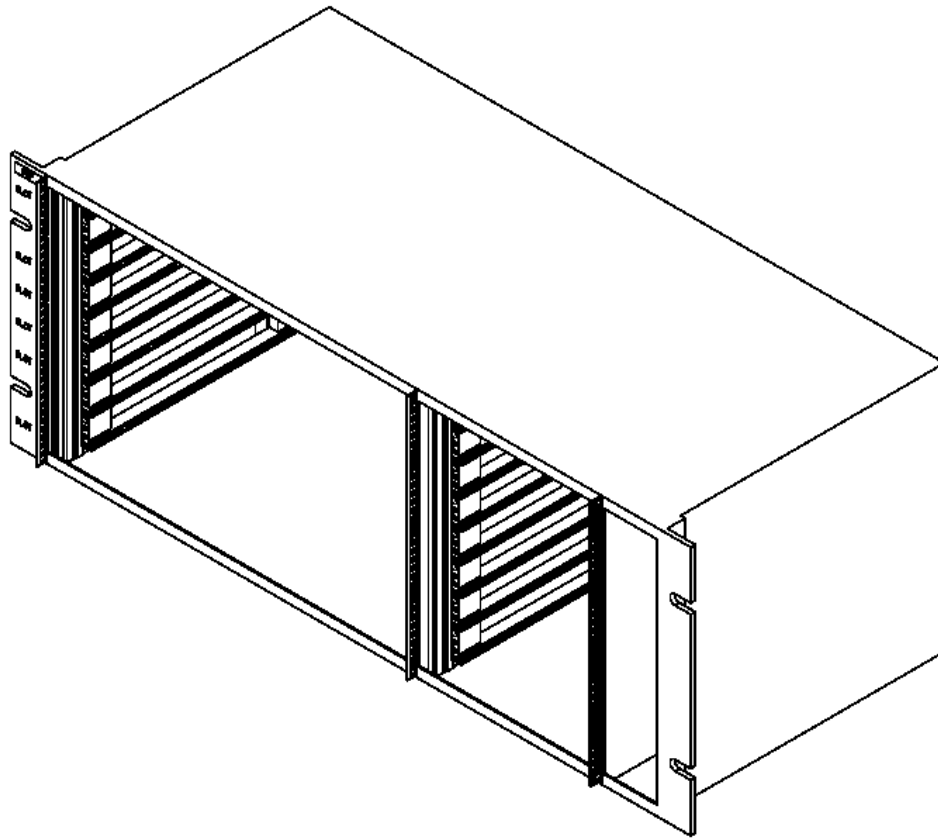


Figure 2-5 Digivance CXD RF Chassis

Modules and circuit cards are placed into the RF Chassis and are mated using standard cPCI connectors on the backplane of the chassis. Data and signals are transported over busses on the backplane of the chassis to other modules and ports on the backside of the chassis.

Rear connections are made to the RF Chassis to connect power, route Digital IF (DIF) signals to inputs and outputs of respective modules, connect the I2C bus to the chassis, input a 1 Hz reference signal, input sample and reference clocks, output FAN tachometer readings to the Digital Chassis, and distribute 12 VDC to other elements of the system. The RF Chassis also has a Module/Port status indicator that can be used to trace signals through the system and show activity on the ports. Figure 2-6 shows the back panel connections for the RF Chassis. The references for the back connectors of the RF Chassis are shown in Table 2-4.

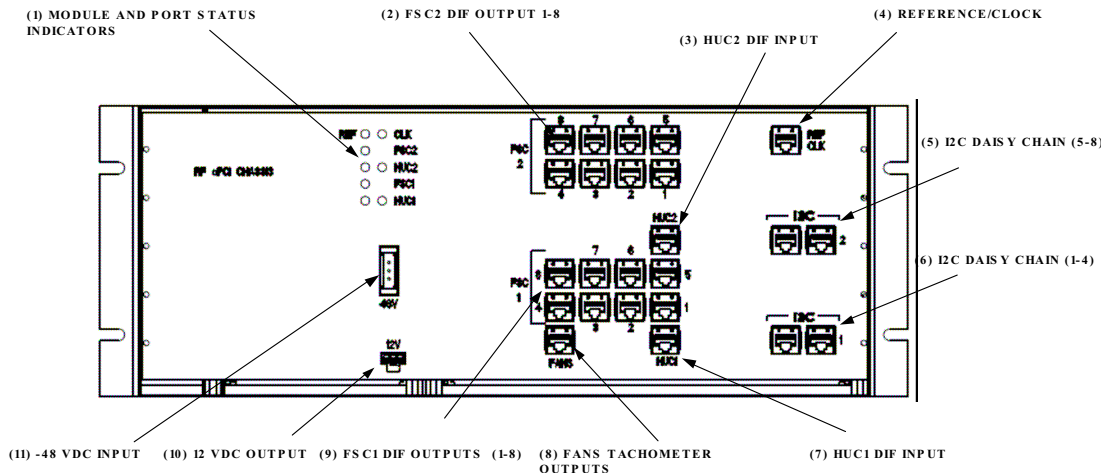


Figure 2-6. RF Chassis – Rear Connectors

Table 2-4. Digital Chassis References – Rear Connectors

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Status Indicators	Multi-colored LED	Indicators showing module and port status (see RF Chassis rear indicators).
2	FSC 2 DIF Output (1-8)	Eight RJ-45 Connectors	FSC DIF outputs. Eight simulcast outputs. Maps to FSC in slot 7.
3	HUC2 DIF Input	Single RJ-45 connector	Two DIF signals into HUC (primary and diversity). Maps to HUC in Slot 5.
4	REF/CLK	One RJ-45 connector	1 pulse per second, Sample, and Reference clocks from HRM.
5	I2C daisy chain (5-8)	Two RJ-45 connectors	One of four I2C busses controlling cards in Slots 5-8. Typically bus B. Must be daisy chained to BIM.
6	I2C daisy chain (1-4)	Two RJ-45 connectors	One of four I2C busses controlling cards in Slots 1-4. Typically bus A. Must be daisy chained to BIM, which in turn can be daisy chained to HRM.
7	HUC1 DIF Input	Single RJ-45 connector	Two DIF signals into HUC (primary and diversity). Maps to HUC in Slot 1.
8	FANS	Single RJ-45 connector	Sends chassis fan speed to Digital Chassis.
9	FSC 1 DIF Output (1-8)	Eight RJ-45 Connectors	FSC DIF outputs. Eight simulcast outputs. Maps to FSC in slot 23.
10	12V	3-pin power output connector	Provides 12V power to BIM.
11	-48V	Single 3-pin power input connector	Provides -48VDC to chassis.

Figure 2-7 shows the RF Chassis viewed from the rear. The references for the back connector of the RF Chassis are shown in Table 2-5.

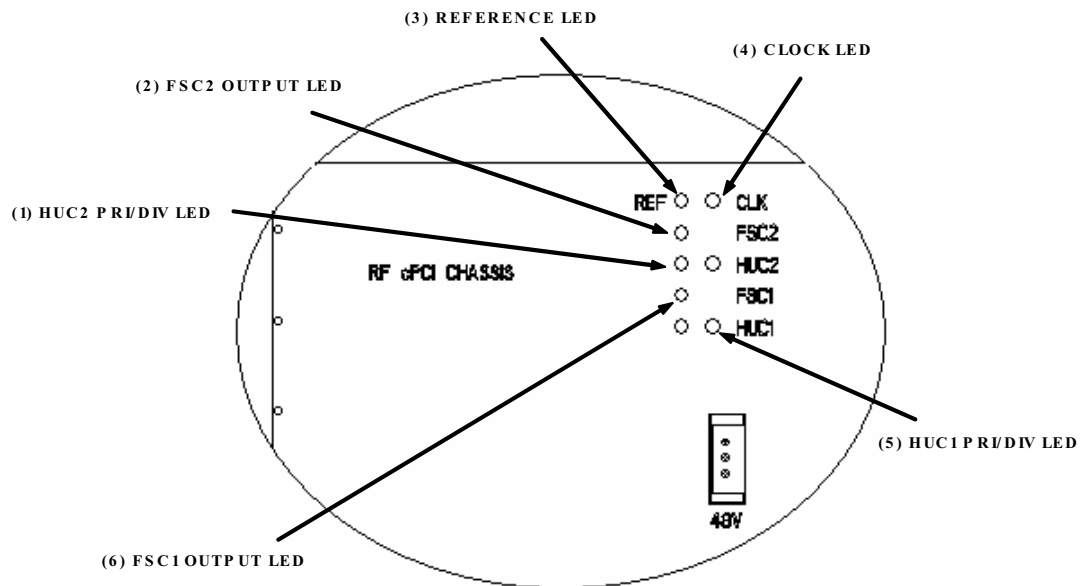


Figure 2-7. RF Chassis – Rear Indicators

Table 2-5. RF Chassis References – Rear Indicators

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	HUC2 LED	One green LED	FUTURE USE. Maps to slot 5.
2	FSC2 LED	One green LED	FUTURE USE. Maps to slot 7.
3	REFERENCE LED	One green LED	Green indicates reference clock is present.
4	CLOCK LED	One green LED	Green indicates sample clock is present.
5	HUC1 LED	One green LED	FUTURE USE. Maps to slot 1.
6	FSC1 LED	One green LED	FUTURE USE. Maps to slot 3.

Figure 2-8 shows an empty RF Chassis from the front. Slots on the left are numbered from 1 to 8 starting at the bottom of the chassis. Slots on the right of the chassis are used for the cPCI power supplies used to power the modules and the cPCI fan assembly. Mounting of modules and circuit cards into the RF Chassis should be done in accordance with Table 2-6.

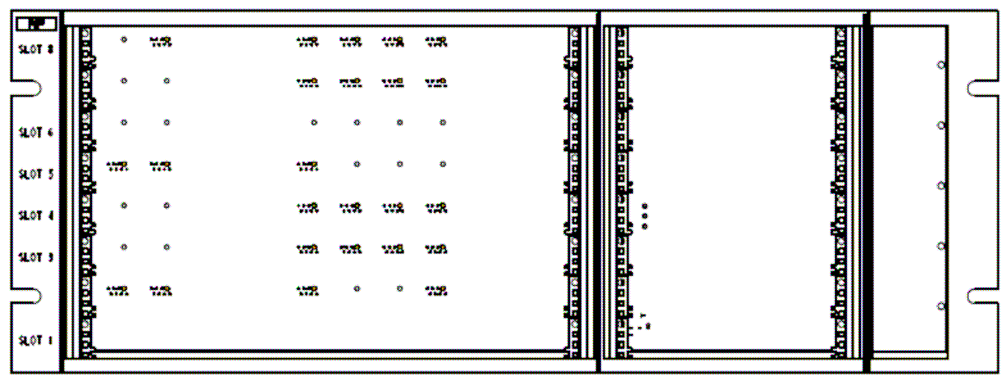


Figure 2-8. RF Chassis – Front

Table 2-6. RF Chassis Slot Assignments

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

4 RADIO ACCESS NODE (RAN)

The Radio Access Node (RAN) is the remote hardware that transmits and receives radio signals. It consists of a cabinet, RAN Chassis, a Central Processing Unit (CPU), a System Interface (STF2), a Sonet Interface (SIF), RAN Down Converter (RDC or RDC2), RAN Up Converter (RUC2.X or RUC3), AC Power Entry Card (APEC), a DC Power Entry Card (DPEC) (battery backup option only), and the RF Assembly consisting of Power Amplifiers, duplexers, and RFA interface controller. There are two cabinet options, the CXD RAN Standard Cabinet, and the CXD RAN Extended Cabinet. The standard cabinet is capable of supporting two Radio Frequency Assemblies (RFA's) with no battery backup or one RFA and one internal battery backup assembly. The extended cabinet is capable of supporting two RFA's and an extended battery backup assembly housed in battery assembly compartment located on the side of the cabinet.

4.1 RAN cabinet

The CXD RAN standard and extended cabinets, shown in Figure 2-9 and Figure 2-10, are NEMA-3R enclosures (with removable dust filter) that provides the following basic functions:

- Houses the various electronic modules including the following
 - RAN Chassis and Backplane
 - Central Processing Unit (CPU)
 - System Interface (STF2)
 - Sonet Interface (SIF)
 - RAN Down Converter (RDC or RDC2)
 - RAN Up Converter (RUC2.X or RUC3)
 - AC Power Entry Card (APEC)
 - DC Power Entry Card (DPEC)
 - RF Assembly (RFA) consisting of Power Amplifiers, duplexers, and RF interface controller.
 - Enclosure and chassis fans
- Houses accessory items such as back-up battery and WDM modules
- Protects all modules from the weather.
- Provides electrical interface connections for the RAN Chassis and RFA modules.
- Provides ventilation openings to allow the entry of cool air and the escape of heated air.

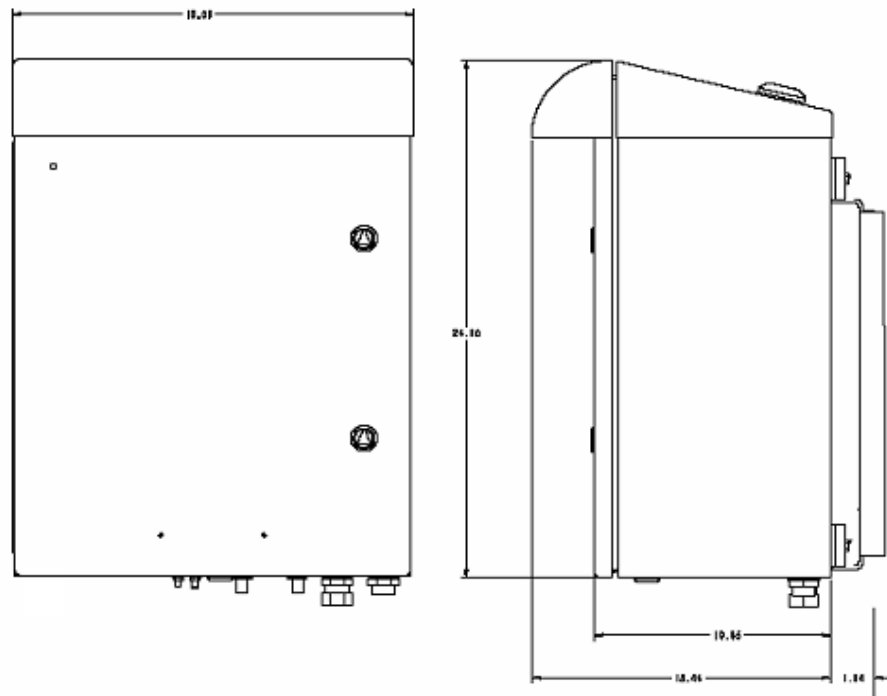


Figure 2-9. CXD RAN Standard Cabinet

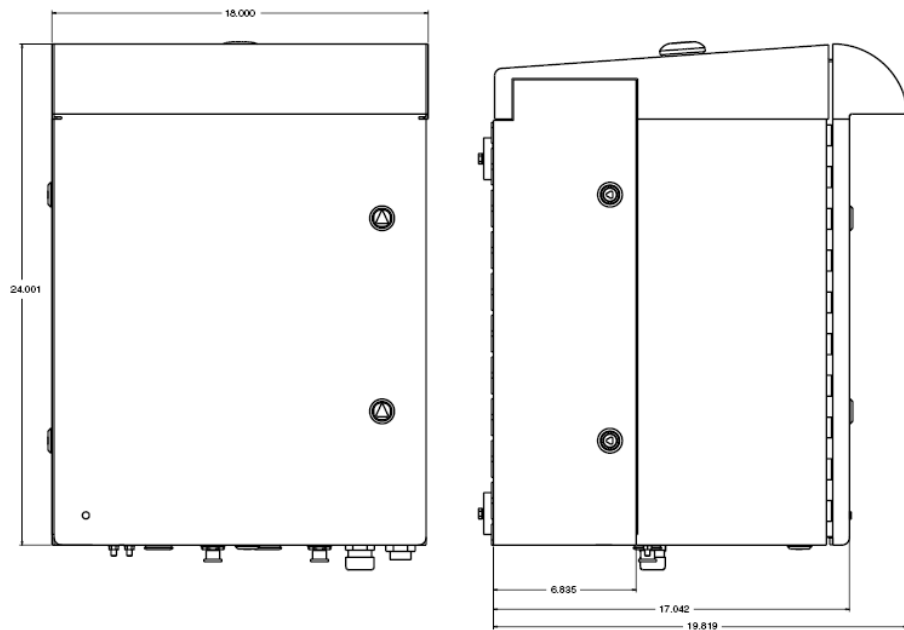


Figure 2-10. CXD RAN Extended Cabinet

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

The CXD RAN cabinets are weather-tight but contact with salt-air mist should be avoided as it may degrade the MTBF of the product. The cabinet can be mounted from a flat-vertical surface, on a wooden utility pole (requires wood pole-mount kit) or from a metal street pole (requires metal pole-mount kit). Slots within the RAN cabinet are designated for either the RAN Chassis or RFA modules.

5 ELEMENTS COMMON TO HUB AND RAN

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

5.1 Central Processor Unit (CPU)

The Hub Central Processor Unit (CPU) installs into the Digital Chassis. There are two CPU types used in the CXD system, Hubmaster and Slave CPUs. The Hubmaster manages its own local hardware as well as controlling the overall system. The Slave CPUs only manage their local hardware. All Slave CPUs communicate to the Hubmaster over a network connection. Figure 2-11 shows the relationship between Hubmaster and Slave CPUs.

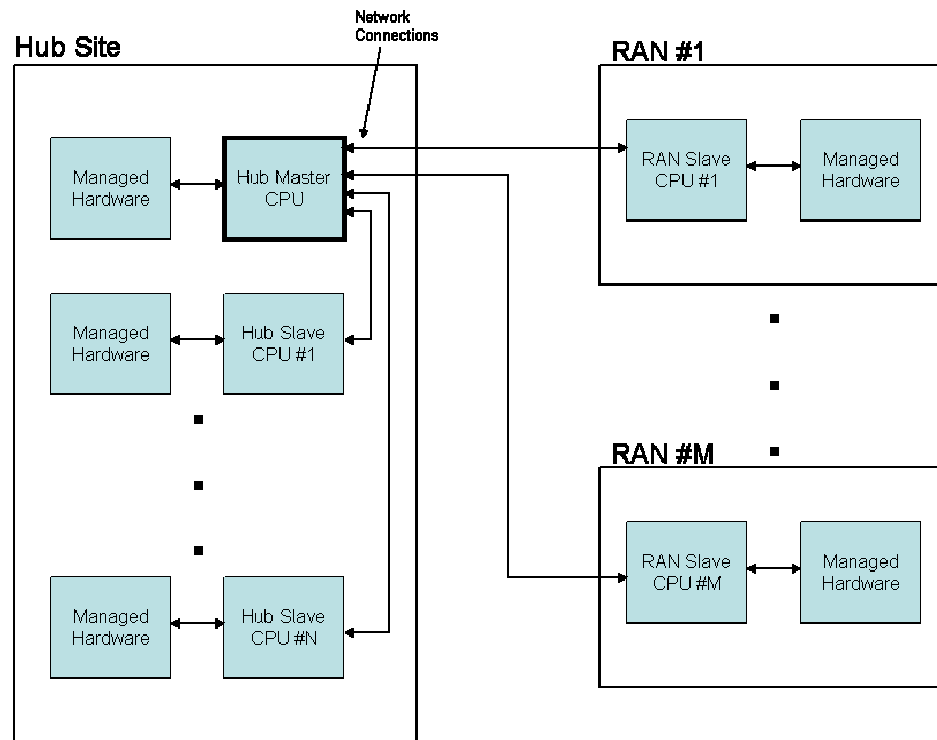


Figure 2-11. Hubmaster and Slave Block Diagram

There is one Hubmaster (HM) CPU per system. All CPUs at the Hub, with the exception of the Hubmaster CPU, are Slave CPUs. The CPU used in the RAN is also a Slave CPU to the Hubmaster CPU. The CPU is shown in Figure 2-12. The references for the CPU are shown in Table 2-7.

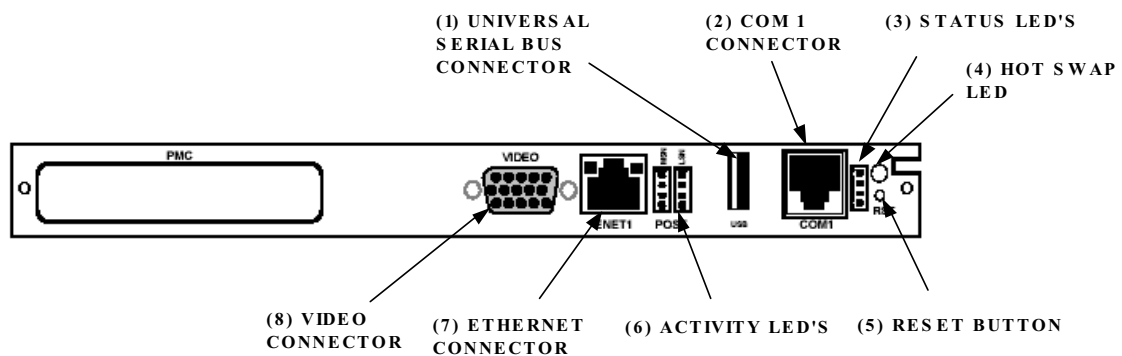


Figure 2-12. CPU Front Panel

Table 2-7. CPU User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Universal Serial Bus Connector	USB connector	Front panel Input/Output for keyboard connectivity.
2	COM 1 Connector	RJ-11C connector	Front panel interface for COM1.
3	Status LEDs	LEDs	LED 1 (red) is hotswap LED 2 & 3 are undefined LED 4 (green) is power
4	Hot Swap LED	Single-colored LED (Red)	Status indicator turns red when board can be hot swap extracted.
5	Reset Button	Recessed switch	Used to manual reset CPU.
6	Activity LED's	Single-colored LED (Amber)	Eight LEDs give status of CPU during initial boot process and four status LEDs for board operation status.
7	Ethernet Connector	RJ-45 connector and single-colored LED (Green and Yellow)	Ethernet connector, 10 BaseT connection status and port activity status indicators
8	Video Connector	15-PIN VGA connector	Not used by Digivance CXD system

5.2 System Interface (STF2)

The System Interface (STF2) module, shown in Figure 2-13, is installed into the Digital Chassis and RAN Chassis and provides the ability to communicate between the CPU and other modules (e.g., FBHDC, FSC, HUC, RUC and RDC), using four I2C busses. The STF2 also communicates with the GPS module found in the Hubmaster Hub Reference Module. The STF2 used at the RAN differs from the module at the Hub in that it has the GPS antenna input located in the center of the module and additional GPS circuitry to control that device. STF2 modules are specified according to the number of qualifying communications devices being utilized. The references for the STF2 are shown in Table 2-8.

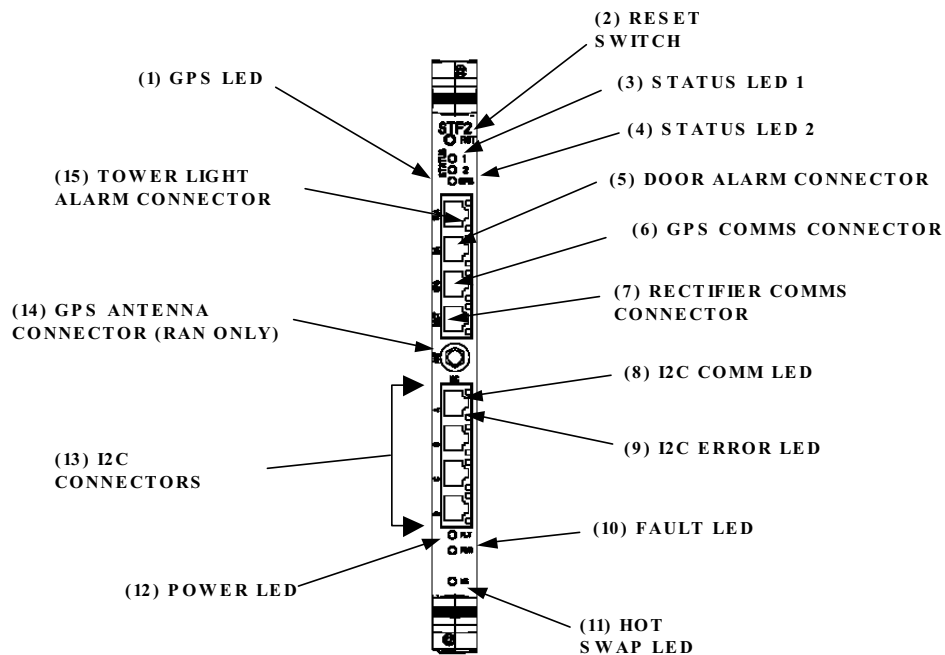


Figure 2-13. STF2 Front Panel

Table 2-8. STF2 User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	GPS LED	Single-color LED (Green)	Indicator showing that 1PPS signal is available. LED toggles once per second (RAN only).
2	Reset Button	Recessed switch	Used to halt operation of the CPU operating system. A power ON reset is required to restart CPU.
3	Status LED 1	Single-colored LED (Yellow)	Reserved for future use. Status indicator turns yellow when CPU is not installed or has malfunctioned.
4	Status LED 2	Single-colored LED (Yellow)	Reserved for future use. Status indicator turns yellow when CPU is not installed or has malfunctioned.
5	Door Switch Input	RJ-45 connector	Door switch input (RAN only)
6	GPS Comms Connector	RJ-45 connector	Communications to HRM GPS (Hub Maser STF only)
7	Rectifier Comms Connector	RJ-45 connector	Communications to rectifier (NXD RAN's only)
8	I2C Comm LED's	Single-colored LED (Green)	On each I2C RJ-45 connector. Status indicator turns green when an I2C message is sent on port.

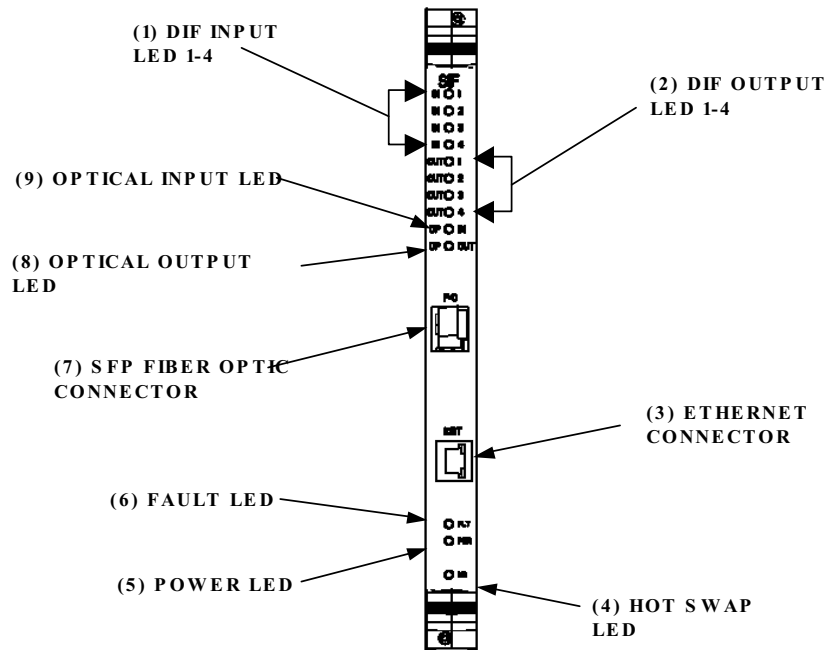
continued

Table 2-8. STF2 User Interface, continued

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
9	I2C Error LED's	Single-colored LED (Red)	On each I2C RJ-45 connector. Status indicator turns red when no response on port.
10	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed or upon startup until the module has completed initialization.
11	Hot Swap LED	Single-colored LED (Blue)	Status indicator turns blue when board can be hot swap extracted. (not used)
12	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
13	I2C Connectors	RJ-45 connectors	I2C interface
14	GPS Antenna	SMA connector	Input for GPS antenna signal (RAN only)
15	Tower Light Alarm Connector	RJ-45 connector	Contact closure for tower light alarm (not used)

5.3 Sonet Interface (SIF)

The Sonet Interface (SIF) module, shown in Figure 2-14, is a Digital Chassis and RAN Chassis module that can be placed in slots designated for either the SIF or RSC (Digital Chassis only). It provides the DIF to optical interface between the Hub and RANs using an optical transceiver. This interface includes RF signal information and 10BaseT Ethernet command and control information.

**Figure 2-14. SIF Front Panel**

The SIF module is able to support up to four independent 15 MHz Digital IF (DIF) data streams (15 MHz band blocks) consisting of either four (4) forward path signals and four (4) reverse path signals in a non-diversity configuration, or two (2) forward path signals and four (4) reverse path signals in a receive-diversity configuration. The references for the SIF are shown in Table 2-9.

Table 2-9. SIF User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	DIF Input 1-4 LED	Multi-colored LED (Green/Yellow/Red)	Indicator showing if the interface is not enabled (off), good (green), degraded (yellow), clock issue (blinking), or no DIF tone lock or unused channel (red).
2	DIF Output 1-4 LED	Multi-colored LED (Green/Yellow/Red)	Indicator showing if the interface is not enabled (off), good (green), degraded (yellow), clock issue (blinking), or bad data on output of unused channel (red).
3	Ethernet Connector	RJ-45 connector	Provides IP connectivity over fiber
4	Hot Swap LED	Single-colored LED (Blue)	Status indicator turns blue when board can be hot swap extracted.
5	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
6	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized.
7	SFP Fiber Optic Connector	Dual-LC connectors	Fiber connector on SFP optical transceiver.
8	Optical Output LED	Multi-colored LED (Green/Yellow/Red)	Indicator showing if the SFP interface is not enabled (off), good (green), degraded (yellow) or bad output signals (red).
9	Optical Input LED	Multi-colored LED (Green/Yellow/Red)	Indicator showing if the SFP interface is not enabled (off), good (green), degraded (yellow) or bad framing, bad parity, no signal, or no signal lock (red).

5.4 Small Form-Factor Optical Transceiver (SFP)

The small form-factor pluggable optical transceiver (SFP), shown in Figure 2-15, provides the optical interface between the Hub equipment and the RAN hardware. The Digivance CXD system uses industry standard SFP optics which offers a number of configuration options depending on the requirements of the project. The SFP modules are typically factory installed with the SIF, or may be purchased separately depending on the system as ordered.

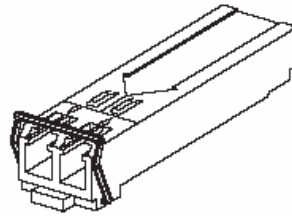


Figure 2-15. SFP Optical Transceiver Module

6 HUB SPECIFIC MODULES

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

6.1 Full Band Hub Down Converter (FBHDC)

The Full Band Hub Down Converter (FBHDC), shown in Figure 2-16, down converts the forward RF carrier to an intermediate frequency (IF) that can be digitized. Each FBHDC can support up to 15 MHz of contiguous spectrum. The FBHDC can be inserted into slots 2, 4, 6 and 8 (see Table 2-6) of the Hub RF Chassis. The references for the FBHDC are shown in Table 2-10.

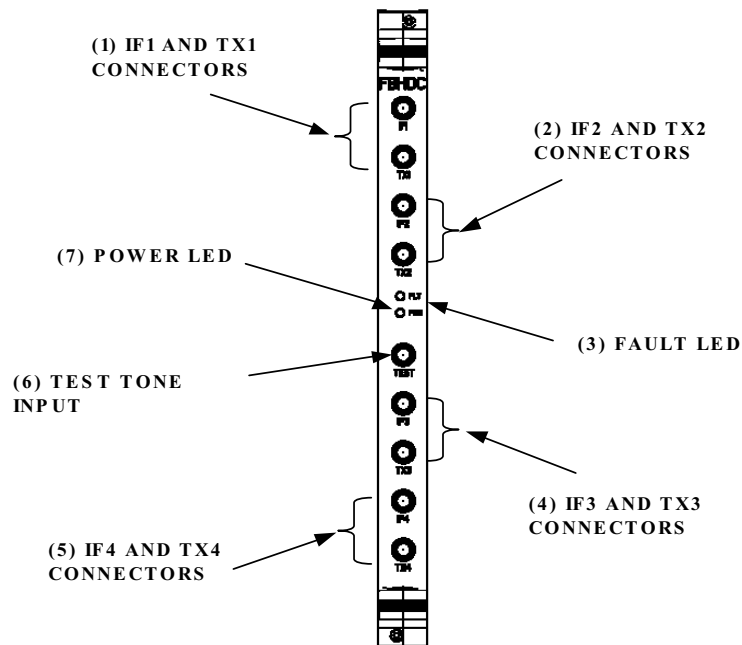


Figure 2-16. FBHDC Module

Table 2-10. FBHDC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	IF1 and Tx1 Connectors	SMA Connector	Connect to FSC and BIM, respectively. If direct connect is desired, supply -4dBm composite power to Tx1 (-7 dBm for iDEN).
2	IF2 and Tx2 Connectors	SMA Connector	Additional downlink path (see Ref(1)).
3	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization
4	IF3 and Tx3 Connectors	SMA Connector	Additional downlink path (see Ref(1)).
5	IF4 and Tx4 Connectors	SMA Connector	Additional downlink path (see Ref(1)).
6	Test	SMA Connector	Accepts test signal from BIM
7	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.

Attenuation is required between the BTS and each input of the FBHDC (in direct connection configuration), or the Tx0 input of the BIM (in duplex mode) to restrict the FBHDC input range to a max composite value of -4dBm (-7 dBm for iDEN). For each channel, a cable is required between this power attenuator and the FBHDC or BIM input.

- One (1) FSC is required per sector. One FSC can accept the output of two (2) FBHDCs per sector.
- One (1) cable is required per FBHDC to carry the test tone from the BIM FWD 1 or 2 ports to the Test input on the FBHDC.

6.2 Forward Simulcast Card (FSC)

The Forward Simulcast Card (FSC), shown in Figure 2-17, converts the IF signals from the FBHDC to Digitized IF (DIF) format. There are eight (8) separate analog-to-digital conversion circuits on one (1) FSC. This module is specified at one per sector per tenant per 8 RANs. The references for the FSC are shown in Table 2-11.

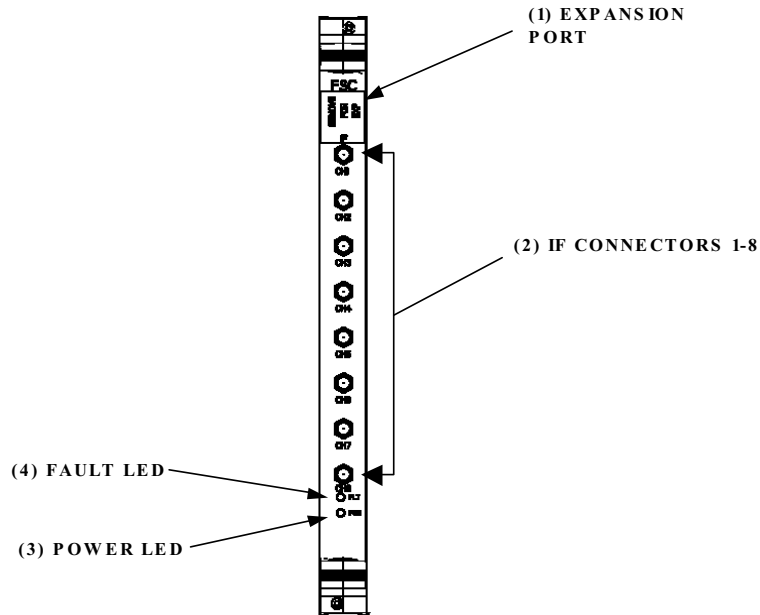


Figure 2-17. Forward Simulcast Card

Table 2-11. FSC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Expansion Port Connector	RJ-45 connector	Optional DIF signal I/O to expansion FSC (unused)
2	IF Connectors 1-8	SMA connectors	IF signal inputs from Hub Down Converter module
3	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
4	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization

6.3 Hub Up Converter Card (HUC)

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

The HUC, shown in Figure 2-18, can be inserted into slots 1 and 5 in the Hub RF cPCI chassis. The outputs of the HUC are cabled to the reverse path inputs of the BIM module. Refer to Table 2-17 for BIM to HUC interconnect. There are two RF cables per HUC for primary and diversity. Cables are routed from BIM down or up to SMA connector of the adjacent HUC. The references for the HUC are shown in Table 2-12.

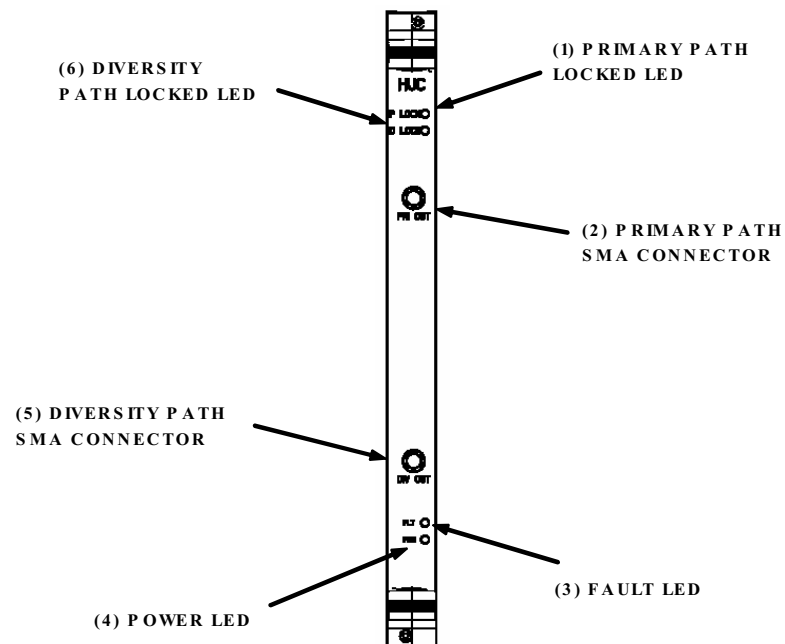


Figure 2-18. HUC Module

Table 2-12. HUC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Primary Path Locked LED	Single-colored LED (Yellow)	Status indicator turns yellow when primary path is locked to RSC or SIF.
2	Primary Path RF connector	SMA connector	RF connector for primary receive path.
3	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization
4	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
5	Diversity Path RF connector	SMA connector	RF connector for diversity receive path.
6	Diversity Path Locked LED	Single-colored LED (Yellow)	Status indicator turns yellow when diversity receive path is locked to RSC or SIF.

6.4 Reverse Simulcast Card (RSC)

The Reverse Simulcast Card (RSC) is shown in Figure 2-19. The RSC sums the Digital IF (DIF) from up to four (4) RANs into a single DIF signal that is sent to the HUC via DIF cables and the chassis rear panel for conversion to RF. The RSC is utilized in the Digital Chassis and is specified as one per tenant per sector per 4 RANs, plus an additional one RSC for RANs 5-7, and an additional one RSC for RAN 8. The references for the RSC are shown in Table 2-13.

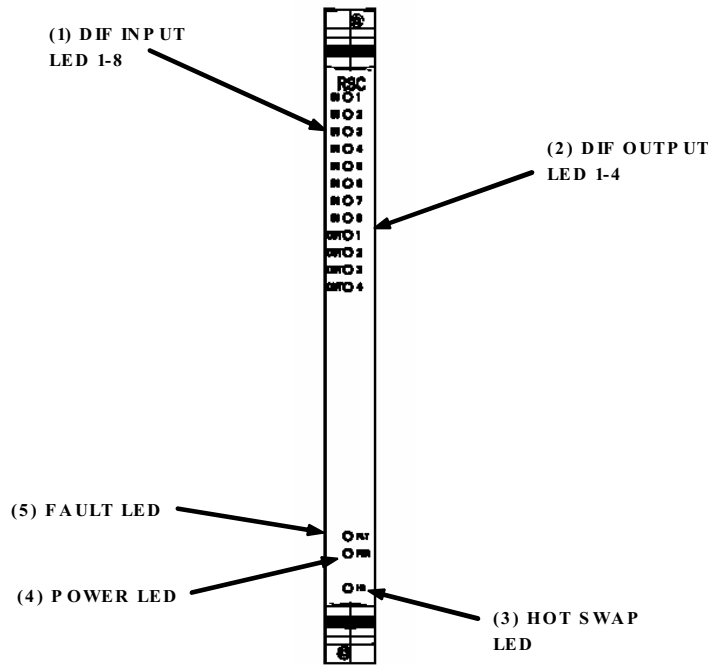


Figure 2-19. RSC Module

The DIF input and output LEDs describe the status of the digital signal. The RSC defaults to using two 4:1 digital simulcast groups. To determine the relationship between the RSC channel LED number and the signal type, use the guidelines in Table 2-13.

Table 2-13. RSC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	DIF Input LED 1-8	Multi-colored LED (Green/Yellow/Red)	Indicator showing if no input signal (off), good (green), degraded (yellow), clock issue (blinking), or bad data on channel (red). IN 1: Band Sector Primary (1st Simulcast) IN 2: Band Sector Primary (2nd Simulcast) IN 3: Band Sector Primary (3rd Simulcast) IN 4: Band Sector Primary (4th Simulcast) IN 5: Band Sector Diversity (1st Simulcast)- if used IN 6: Band Sector Diversity (2nd Simulcast)- if used IN 7: Band Sector Diversity (3rd Simulcast)- if used IN 8: Band Sector Diversity (4th Simulcast)- if used
2	DIF Output LED 1-4	Multi-colored LED (Green/Yellow/Red)	Indicator showing if no input signal (off), good (green), degraded (yellow), clock issue (blinking), or bad data on channel (red). OUT 1: Band Sector-Primary OUT 2: Band Sector-Diversity- if used OUT 3: Not Used OUT 4: Not Used

continued

Table 2-13. RSC User Interface, continued

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
3	Hot Swap LED	Single-colored LED (Blue)	Status indicator turns blue when board can be hot swap extracted.
4	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
5	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed.

6.5 Hub Reference Module (HRM)

The Hub Reference Module (HRM) is used to:

- Provide clock referencing (RF and digital) to the cPCI chassis.
- Interface to GPS antenna.
- Provide 1PPS, derived from GPS, to Digital Chassis for delay management.

For every Hubmaster CPU there is only one Master HRM. This unit is the interface to the GPS antenna. The Hub rack managing this Master HRM must be setup to monitor the GPS antenna. Therefore, only the Master HRM must be monitored for “antenna feedline” fault status. All other HRMs must be daisy chained to this GPS input. Starting with the Master HRM, connect “GPS AUX” of the donor HRM to “GPS IN” of the next HRM in line using an SMA coax cable.

For simulcasting, redundancy, and other functions, HRMs must also share the same clock reference across multiple racks. This is accomplished by daisy-chaining the reference via RJ-45 ports on the back of the unit (see figure 2-21). Starting with “9.6 MHz” RJ-45 port “B” of the Hubmaster HRM, connect a crossover CAT-5 from port B of each donor HRM to port A of the next HRM in line. Port B will remain open on the last HRM in the chain. Be sure to daisy chain HRMs prior to powering them on or connecting them to I2C.

The HRM front panel is shown in Figure 2-20. The references for the HRM front panel are shown in Table 2-14. The HRM rear panel is shown in Figure 2-21. The references for the HRM rear panel are shown in Table 2-15.

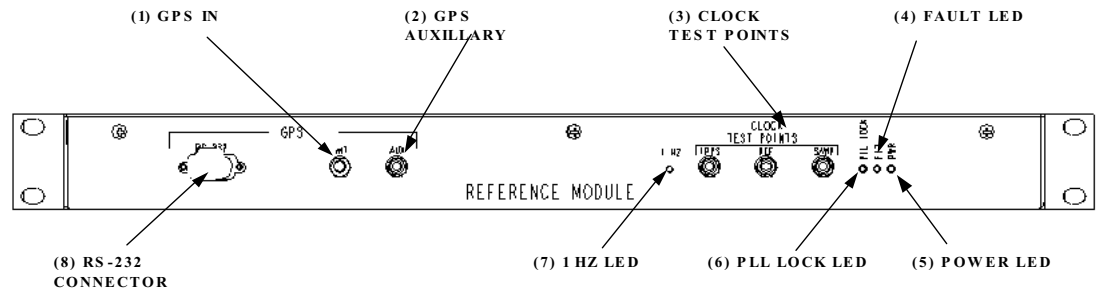


Figure 2-20. Hub Reference Module Front Panel

Table 2-14. HRM Front Panel User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	GPS Input Connector	SMA connector	Input of GPS antenna signal.
2	GPS Auxiliary	SMA connector	Auxiliary GPS output for daisy-chaining.
3	Clock Test Points	SMA connectors	Used for testing of reference clocks
4	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed.
5	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
6	PLL Lock	Single-colored LED (Yellow)	Status indicator turns yellow when phase lock loop circuit is locked
7	1 Hz LED	Single-colored LED (Yellow)	Status indicator toggles at the rate of 1 PPS when 1 Hz signal detected
8	GPS RS-232	DB9 connector	GPS comms to STF2 module

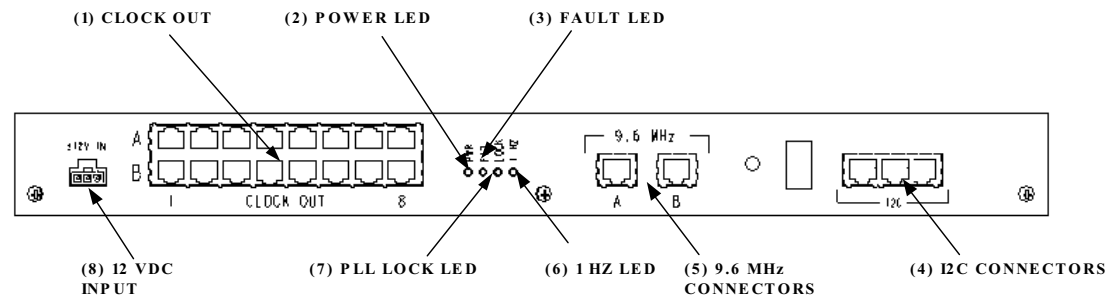


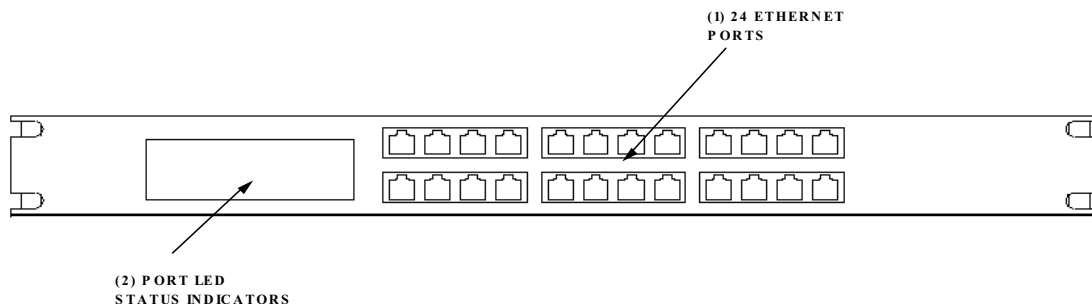
Figure 2-21. Hub Reference Module Rear Panel

Table 2-15. HRM Rear Panel User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Clock Out (A1-8, B1-8)	RJ-45	Sample clock, Reference clock, and 1PPS output connectors (x16)
2	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.
3	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed.
4	I2C Connectors	RJ-45 connectors	I2C interface (x3)
5	9.6 MHz connectors	RJ-45 connectors	Used for HRM daisy-chaining between racks.
6	PLL Lock LED	Single-colored LED (Yellow)	Status indicator turns yellow when phase lock loop circuit is locked
7	1 Hz LED	Single-colored LED (Yellow)	Status indicator toggles at a rate of 1 PPS when 1 Hz signal detected
8	12 VDC Input	3-pin molex	Input power to HRM

6.6 Ethernet Hub

The Ethernet Hub (or Ethernet Switch sold as optional item) is used to consolidate Ethernet connections within a Hub rack. The module is a commercially available unit rated for industrial use and is available as an accessory item to the Digivance CXD system. The standard Ethernet Hub requires 120 VAC power. For projects requiring all DC connections a -48 VDC Ethernet Switch is available as an option. Figure 2-22 shows the layout of a 24 port 120 VAC Ethernet Hub. The references for the Ethernet Hub front panel are shown in Table 2-16.

**Figure 2-22. Ethernet Hub Interconnect****Table 2-16. Ethernet Hub Front Panel User Interface**

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

6.7 BTS Interface Module (BIM)

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

- Interface to a low power forward BTS RF path.
- Handles duplexed and non-duplexed signals.
- Forward path gain adjustment.
- Reverse path gain adjustment.

The BIM, shown in Figure 2-23, is a 1RU module that mounts into the HUB Base Rack. There are four (4) BIM types depending on the frequency band to be supported: Cellular, SMR A, SMR B, or PCS. The references for the BIM front panel are shown in Table 2-17.

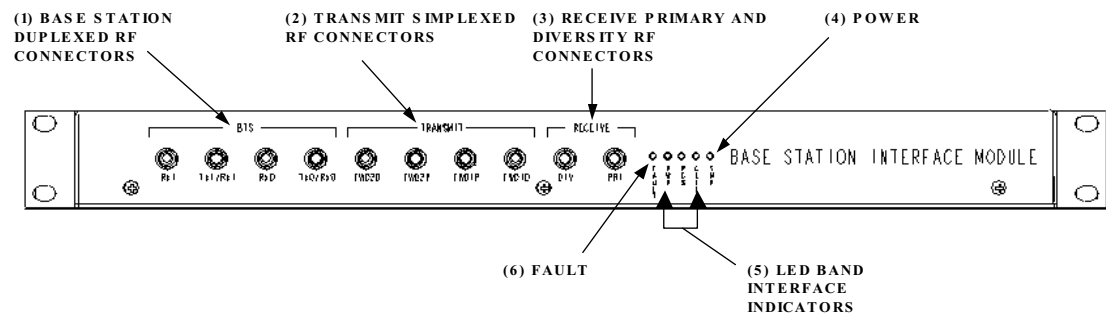


Figure 2-23. BTS Interface Module

Table 2-17. BIM Front Panel User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Base Station RF Connectors	Four SMA connectors	Tx0/Rx0 & Tx1/Rx1 duplexed connections Rx0/Rx1 used for non-duplexed
2	Transmit Forward Path RF Connectors	Four SMA connectors	Forward path connections to FBHDC Fwd1P/Fwd2P – Summed Tx0/Tx1 Fwd1D/Fwd2D – Separated Tx0/Tx1
3	LED Indicators	Red LED Green LED Yellow LED Yellow LED Yellow LED	Fault– Lighted when module fault Power– Lighted when power present PCS– BIM supports the PCS band Cell– BIM supports Cell band SMR– BIM Supports SMR band
4	Receive Reverse path RF Connectors	Two SMA connectors	Connect to HUC module. Primary and diversity connections

The BIM is designed to support the desired interface to the wireless service provider BTS. The BIM can support all duplex or simplex configurations. The standard BIM input power level is low power; -10 to +26 dBm composite. A high power option can be ordered to support a BTS feed 42 to 47 dBm composite per connection. Dual receive and transmit diversity is also provided in the BIM.

There are three typically configurations for the BIM Module. Refer to the figure specified for a diagram of each configuration.

1. BIM Basic – Two cable duplexed interface (see Figure 2-24).
2. Direct Cable – Forward path bypasses, reverse path still used (see Figure 2-25).
3. Transmit Diversity – Keep Tx0/Tx1 separated (see Figure 2-26).

Table 2-18 shows how to connect a BIM for all possible RF connections. One BIM is required per tenant sector.

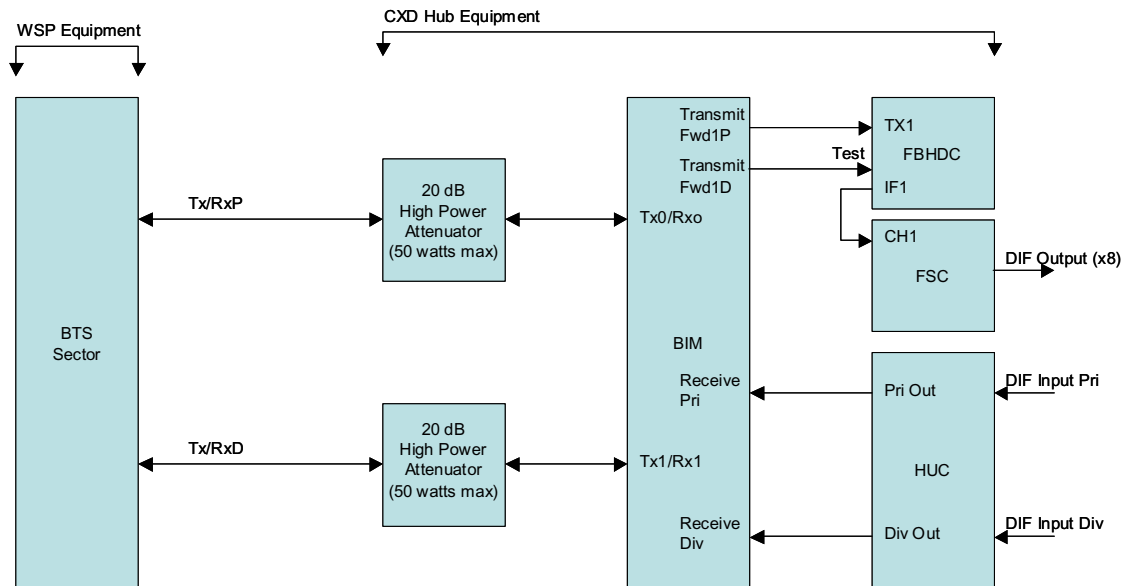


Figure 2-24. BIM Basic Configuration

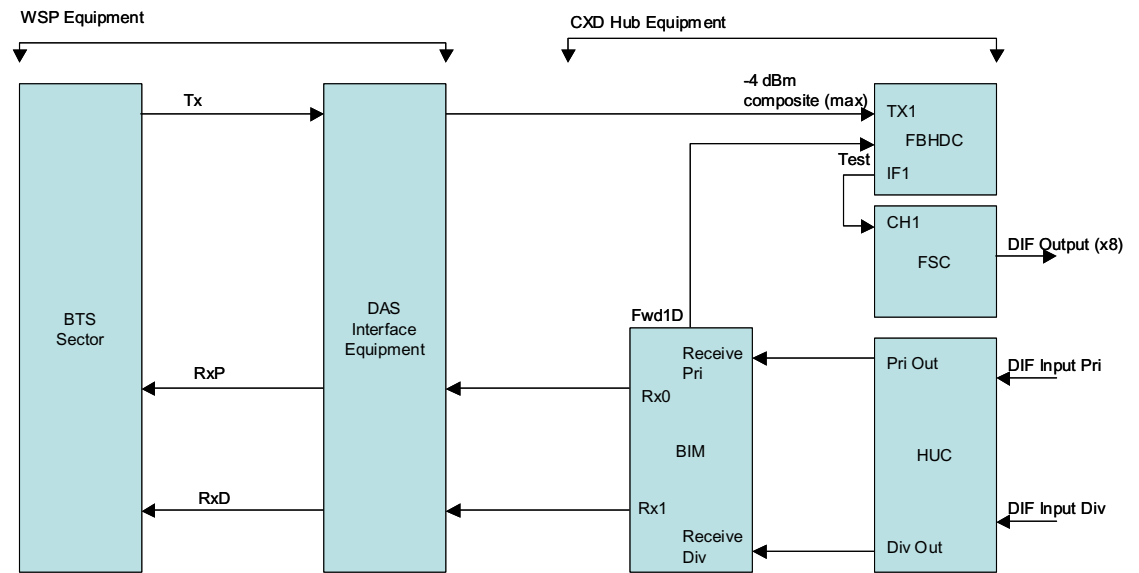


Figure 2-25. Direct Cable Configuration

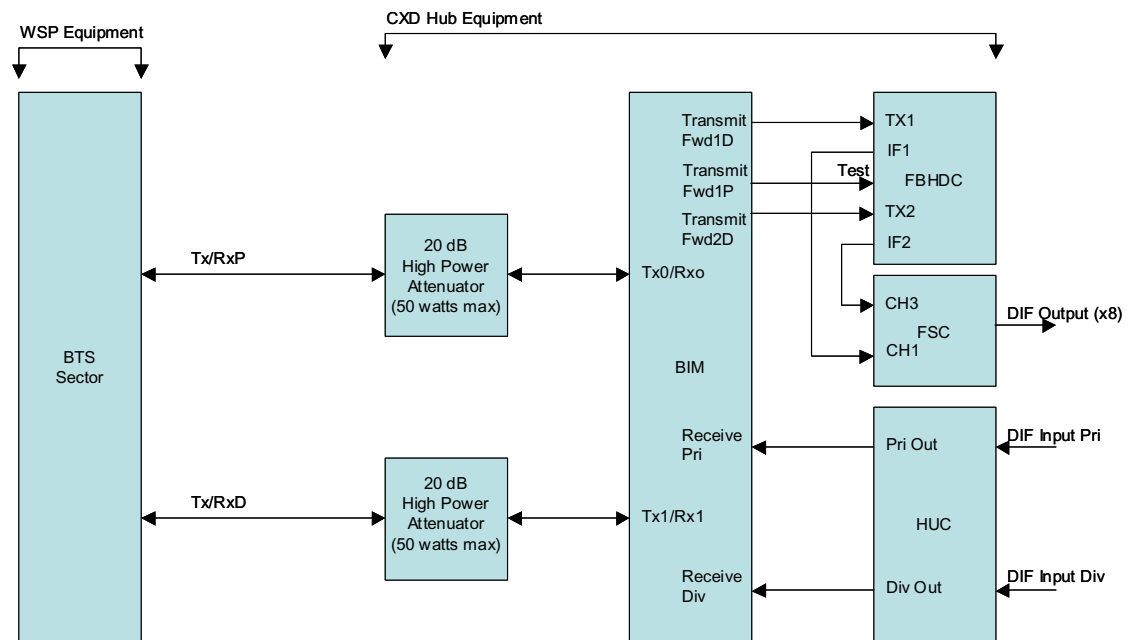


Figure 2-26. Transmit Diversity

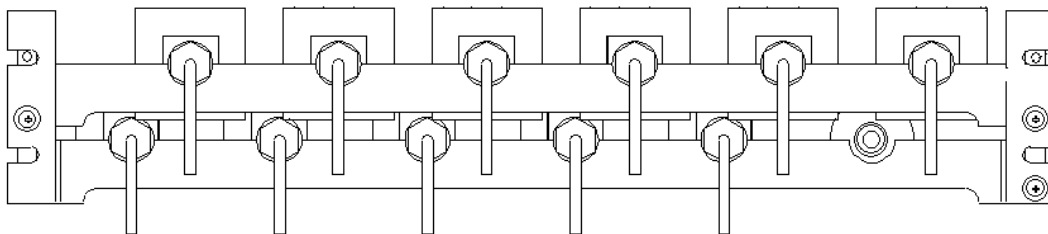
Table 2-18. BIM RF Connections

CONFIGURATION	FROM	TO
BIM Basic	BIM BTS TX0/RX0	High Power Attenuator X
	BIM BTS TX1/RX1	High Power Attenuator Y
	Transmit Fwd1P	FBHDC Tx1
	Transmit Fwd1D	FBHDC Test
	Receive RX0	HUC PRI
	Receive RX1	HUC DIV
Direct Cable	WSP BTS Tx	FBHDC Tx1
	WSP BTS RxP	BIM Rx0
	WSP BTS RxD	BIM Rx1
	BIM Receive PRI	HUC PRI
	BIM Receive DIV	HUC DIV
Transmit Diversity	BIM BTS TX0/RX0	High Power Attenuator X
	BIM BTS TX1/RX1	High Power Attenuator Y
	Transmit Fwd1D	FBHDC Tx1
	Transmit Fwd2D	FBHDC Tx2
	Transmit Fwd1P	FBHDC Test
	Receive RX0	HUC PRI
	Receive RX1	HUC DIV

► **Note:** The Digivance CXD/NXD Hub is very flexible and is capable of other interface options. Contact ADC directly for other options.

6.8 Attenuator Shelf

The attenuators are mounted on an attenuator shelf. The attenuator shelf, shown in Figure 2-27, is mounted at the top of the Hub rack. It can hold up to twelve (12) 50 watt attenuators. One attenuator can handle up to a 47 dBm composite signal level.

**Figure 2-27. Attenuator Shelf**

7 RADIO ACCESS NODE (RAN) SPECIFIC MODULES

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

7.1 Ran Down Converter (RDC or RDC2)

The RAN Down Converter (RDC), shown in Figure 2-28, takes RF signals from a primary and secondary antenna and down converts the signals into IF. Signals are input into the card over coax cable terminated with SMA connectors on to the front panel of the module. The references for the RDC user interface are shown in Table 2-19. Two versions of the RDC, the RDC and RDC2, are available.

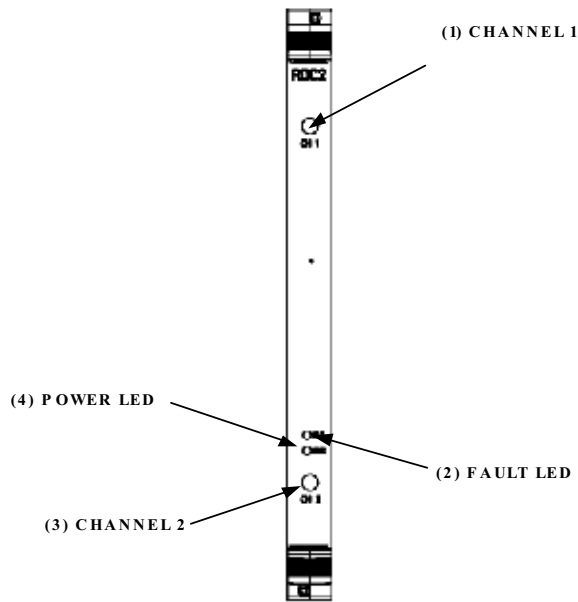


Figure 2-28. RDC Front Panel

Table 2-19. RDC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Channel 1 RF Connector	SMA connector	RF input for Channel 1
2	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization
3	Channel 2 RF Connector	SMA connector	RF input for Channel 2. Used in diversity systems or 3/4 bands systems (future)
4	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.

7.2 Ran Up Converter (RUC2.X or RUC3)

The RAN Up Converter (RUC), shown in Figure 2-29, takes IF signals from a DIF signal generated by a SIF and up converts the signals to RF. The RF outputs of the RUC are connected to the RFA's using coax cable jumpers. The RUC is used to monitor and control the RFA and communicates over the provided cable using I2C. The references for the RUC user interface are shown in Table 2-20. Two versions of the RUC, the RUC2.X and RUC3, are available.

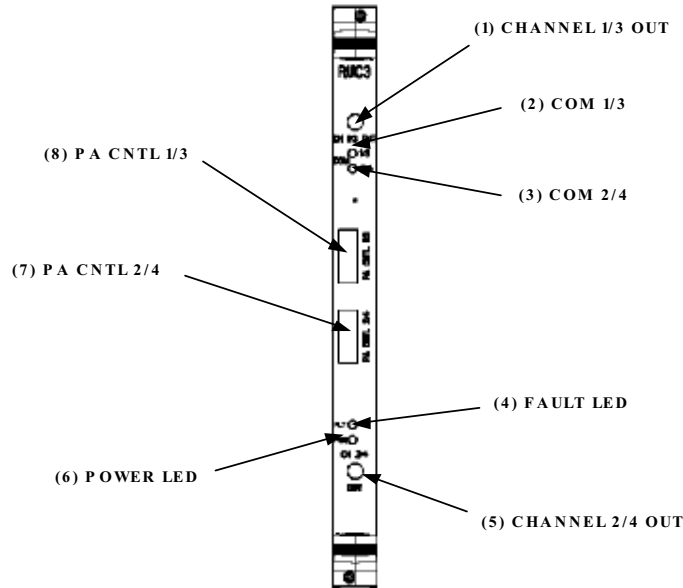


Figure 2-29. RUC Front Panel

Table 2-20. RUC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Channel 1/3 Out Connector	SMA connector	RF output for signal coming from RAN SIF OUT channel 1 or 3
2	COM 1/3 LED	Single-colored LED (Yellow)	Status indicator turns yellow when DIF lock to SIF Channel 1 or 3
3	COM 2/4 LED	Single-colored LED (Yellow)	Status indicator turns yellow when DIF lock to SIF Channel 2 or 4
4	Fault LED	Single-colored LED (Red)	Status indicator turns red when module has failed. Indicator is lit during start-up until the module has initialized. Indicator will blink after module receives a system clock and is awaiting initialization
5	Channel 2/4 Out Connector	SMA connector	RF output for signal coming from RAN SIF OUT channel 2 or 4
6	Power LED	Single-colored LED (Green)	Status indicator turns green when module has power.

continued

Table 2-20. RUC User Interface, continued

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
7	PA CNTL 2/4	I2C flatpack Connector	I2C Communications to RFA
8	PA CNTL 1/3	I2C flatpack Connector	I2C Communications to RFA

7.3 AC Power Entry Controller

The AC Power Entry Controller (APEC) is used for installations requiring AC power only. It has a 100-240 VAC input and has an EMI filter to condition the signal. The APEC provides the following functions:

- AC Power for the cPCI power supplies
- Fan tachometer monitoring and control
- FAN fault indicator LED's
- Future growth for I2C and GPS connections to backplane (not currently used).

The APEC contains two fan controllers that control and monitor the six enclosure fans that are used to cool the RAN enclosure. The APEC front panel has an IEC-320 for AC power entry and 16-pin Molex connector near the top connects to both the enclosure Fans and the RF Assembly (RFA). The RFA provides +28VDC power to the APEC, which uses this power to provide PWM signals to the six enclosure fans. The APEC front panel is shown in Figure 2-30 and the user interface is described in Table 2-21.

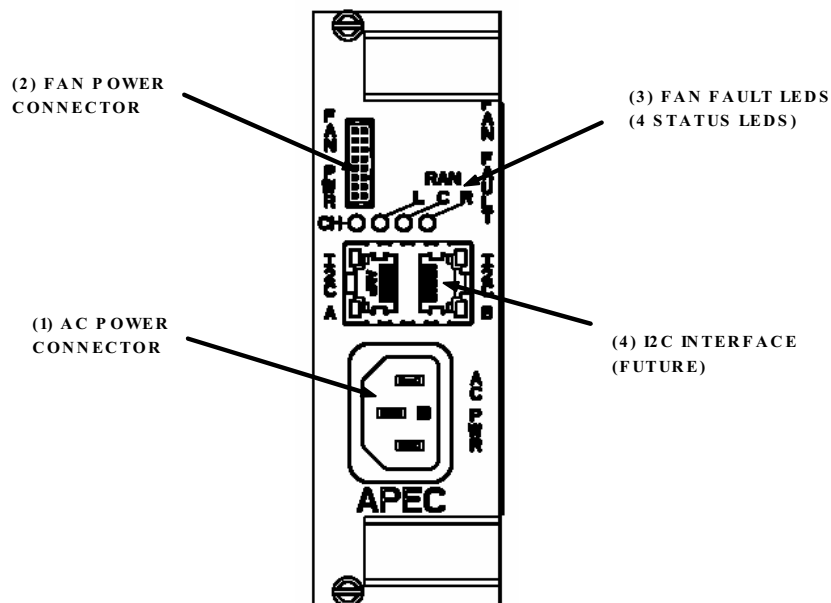
**Figure 2-30. AC Power Entry Controller (APEC)**

Table 2-21. APEC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	AC Power Input Connector	3-wire AC power cord connector	Provides AC power into the cPCI chassis
2	Fan Power Connector	20 pin enclosed header connector	Provides power to chassis and enclosure fans. Monitors fan speeds
3	Fan fault LEDS	LED (red)	CH – cPCI chassis fans not turning L – Left two enclosure fans not turning C – Center two enclosure fans not turning R – Right two enclosure fans not turning
4	I2C Connectors	RJ45 connector	Reserved for future use

7.4 DC Power Entry Controller (DPEC)

The DC Power Entry Controller (DPEC) is used for any installation requiring battery backup. It provides the following functions:

- DC Power for cPCI power supplies
- Fan tachometer monitoring and control
- FAN fault indicator LED's
- Future growth for I2C and GPS connections to backplane (not currently used)
- Battery controller
 - i. Charge controller
 - ii. Low Voltage Disconnect
 - iii. Temperature monitor
 - iv. Fault detection

The DPEC powers the six-slot chassis from the +28VDC power supplies located in the RF Assemblies. The DPEC provides swap-over circuitry which monitors the +28VDC input and switches to battery if this input power disappears. It also charges the battery as necessary when normal operating power is present. The DPEC front panel is shown in Figure 2-31 and the user interface is described in Table 2-22.

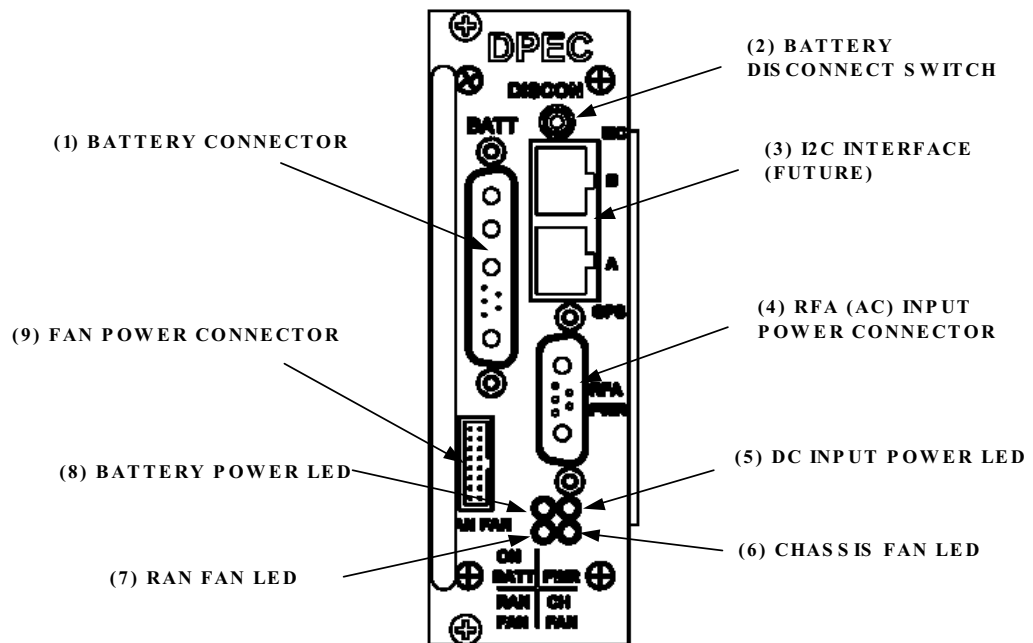


Figure 2-31, DC Power Entry Controller (DPEC)

Table 2-22. DPEC User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Battery Connector	Multi-pin connector	Battery cable connector.
2	Battery Disconnect	Push button	Pushed to disconnect batteries from powering RAN.
3	I2C Connectors	RJ45 connector	Reserved for future use.
4	RFA (DC) Power Input Connector	DB 9 connector	Provides DC power into the cPCI chassis from the RFA Module.
5	DC Power Input LED	LED (green)	Lighted when DC power is present.
6	RAN Chassis fan	LED (red)	Lighted when cPCI chassis fans have faulted
7	RAN fan	LED (red)	Lighted when RAN enclosure fans have faulted
8	Battery Power	LED (yellow)	Lighted when RAN is being powered by the batteries.
9	Fan Power Connector	20 pin enclosed header connector	Provides power to chassis and enclosure fans. Monitors fan speeds.

7.5 CompactPCI Power Supply (cPCI P/S)

7.5.1 AC cPCI Power Supply

The AC cPCI P/S distributes power to the CXD Ran Chassis cPCI modules. It is used in the RAN Chassis for applications requiring AC only (no battery backup option). The AC cPCI is shown in Figure 2-32 and the user reference is shown in Table 2-23.

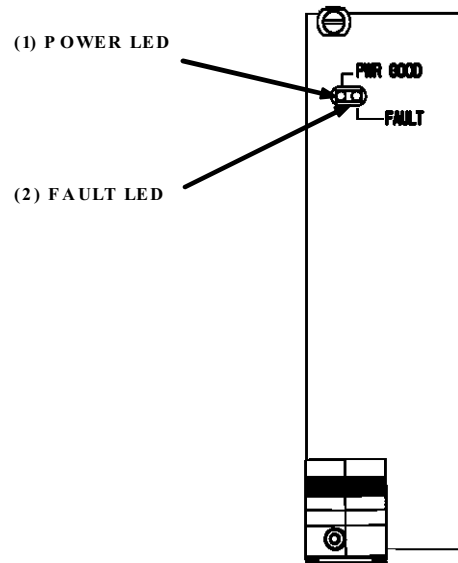


Figure 2-32. RAN Chassis AC cPCI Power Supply

Table 2-23. AC cPCI P/S User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Power LED	Single-colored LED (Green)	Status indicator turns green when power supply has power.
2	Fault LED	Single-colored LED (Yellow)	Status indicator turns yellow when power supply has failed

7.5.2 DC cPCI Power Supply

The DC cPCI P/S, shown in Figure 2-33, distributes power to the CXD Ran Chassis when configured for the battery backup option. It is not used for standard AC power only configurations. The user reference is shown in Table 2-24.

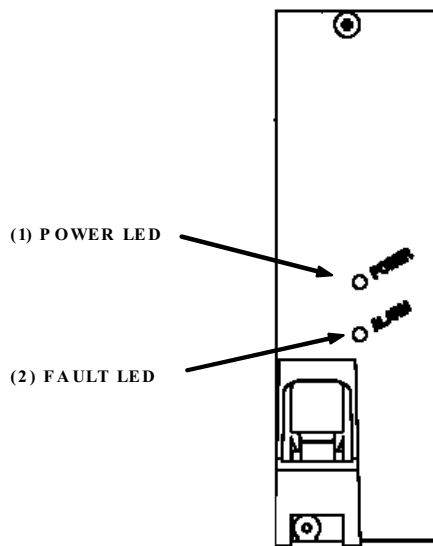


Figure 2-33. RAN Chassis DC cPCI Power Supply

Table 2-24. DC cPCI P/S User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	Power LED	Single-colored LED (Green)	Status indicator turns green when power supply has power.
2	Alarm LED	Single-colored LED (Yellow)	Status indicator turns yellow when power supply has failed

7.6 RF Assembly Module (RFA)

The Radio Frequency Assembly (RFA) is used to amplify the forward path RF output signal, receive the reverse path RF signals and amplify the signals with a low noise amplifier, duplex RF signals and filter out-of-band emissions and signals. On the forward path RF signal passes to the RFA from the Ran Up Converter (RUC) for amplification, filtering and duplexing and output in the antenna port on the module. On the reverse path, signals are separated by the duplexer, filtered, and amplified by a Low Noise Amplifier (LNA) which sets the noise figure of the system. Signals are passed to the Ran Down Converter.

The RFA contains redundant power supplies. In the event that one supply fails, the other unit will maintain power to the RFA and the power LED will be lighted.

There are several types of RFA's depending on the band, number of power amplifier, and signal combining using diplexers. The RFA's may be used with the CXD standard and extended battery cabinet. Other cabinet options are available as accessory items.

The RFA consists of an electronic component circuit board assembly and fan assembly that are mounted within a sheet metal enclosure. The metal enclosure provides a mounting point for the electronic components and controls RF emissions. Except for the fan assembly, the electronic components are not user replaceable. All controls, indicators, and switches are mounted on the RFA front panel for easy access. A carrying handle is provided on the front of the RFA to facilitate installation and transport. A single-band 10 W RFA is shown in Figure 2-34.

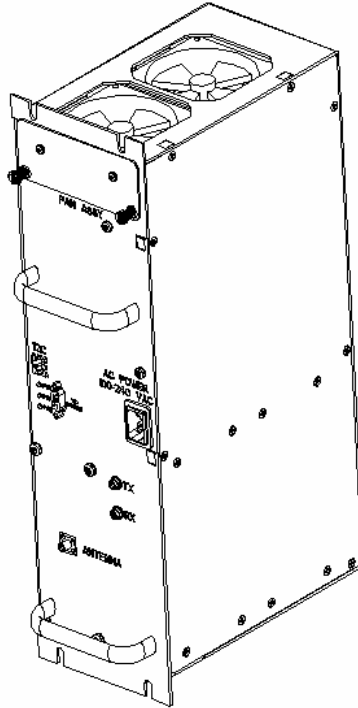


Figure 2-34. Single-Band 10 Watt Radio Frequency Assembly (RFA)

7.6.1 Single-Band 10 Watt RFA

The single-band 10 Watt RFA user interface consists of various LED's, power, communications and RF connectors. The RFA user interface is shown in Figure 2-35 and described in Table 2-25.

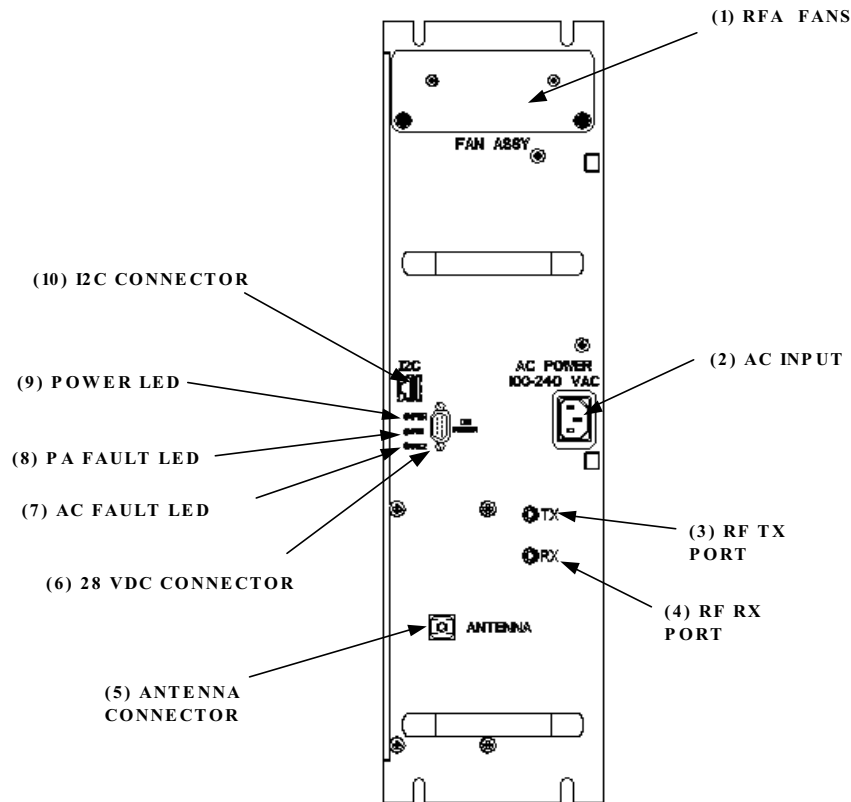


Figure 2-35. Single-Band 10 Watt RF Assembly Module Front Panel

Table 2-25. Single-Band 10 Watt RFA User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	RFA Fans	Fan tray assembly	Access panel of RFA assembly
2	AC Input	3-prong connector	AC power interface IEC-320
3	RF Tx Port	SMA connector	RF transmit input signal from RUC
4	RF Rx Port	SMA connector	RF receive output signal from duplexer
5	Antenna Connector	SMA connector	Duplexed transmit and receive RF signals interface into antenna

continued

Table 2-25. Single-Band 10 Watt RFA User Interface, continued

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
6	28 VDC Connector	DB-9 connector	Connects to fan assembly in AC configuration. Connects to DPEC when battery backup is used.
7	AC Fault LED	Single-colored LED (Red)	Status indicator turns red when redundant power supply of RFA has failed
8	PA Fault LED	Single-colored LED (Red)	Status indicator turns red when power amplifier has failed
9	Power LED	Single-colored LED (Green)	Status indicator turns green when RFA has power.
10	I2C	RJ-45 connector	I2C communications interface

7.6.2 Dual-Band 10 Watt RFA

The dual-band 10 Watt RFA user interface consists of various LED's, power, communications and RF connectors. The RFA user interface is shown in Figure 2-36 and described in Table 2-26.

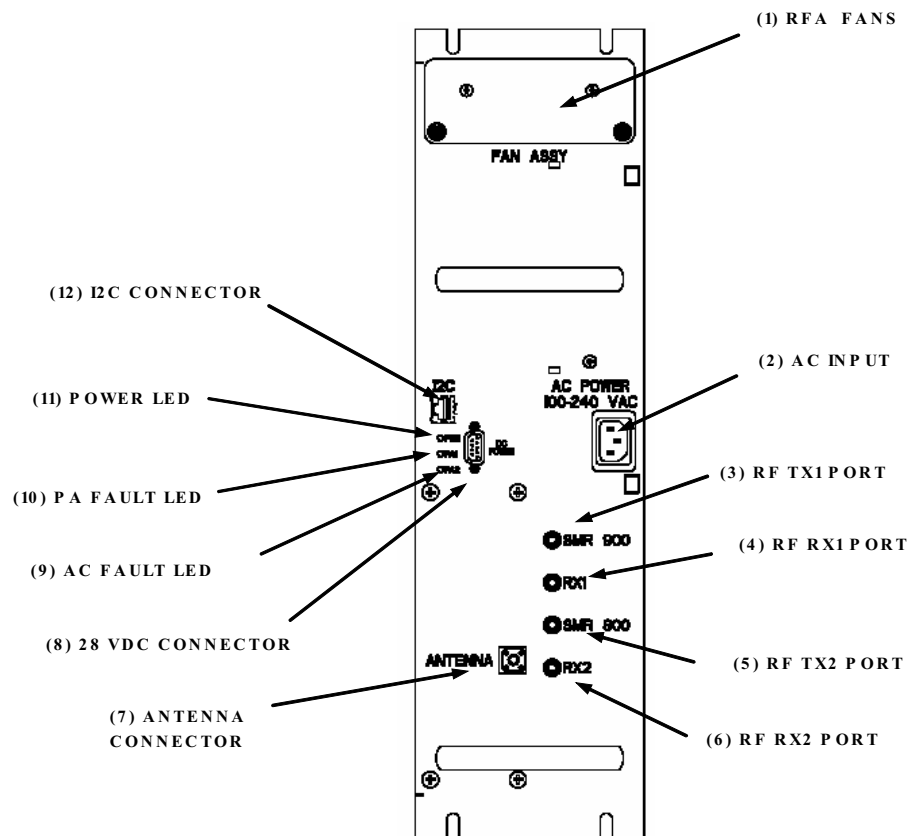
**Figure 2-36. Dual-Band 10 Watt RF Assembly Module Front Panel**

Table 2-26. Dual-Band 10 Watt RFA User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	RFA Fans	Fan tray assembly	Front panel of RFA assembly
2	AC Input	3-prong connector	AC power interface IEC-320
3	RF Tx1 Port	SMA connector	RF transmit input signal from RUC
4	RF Rx1 Port	SMA connector	RF receive output signal from duplexer
5	RF Tx2 Port	SMA connector	RF transmit input signal from RUC
6	RF Rx2 Port	SMA connector	RF receive output signal from duplexer
7	Antenna connector	SMA connector	Duplexed transmit and receive RF signals interface into antenna
8	28 VDC Connector	DB-9 connector	Connects to fan assembly in AC configuration. Connects to DPEC when battery backup is used.
9	AC Fault LED	Single-colored LED (Red)	Status indicator turns red when redundant power supply of RFA has failed
10	PA Fault LED	Single-colored LED (Red)	Status indicator turns red when power amplifier has failed
11	Power LED	Single-colored LED (Green)	Status indicator turns green when RFA has power.
12	I2C	RJ-45 connector	I2C communications interface

7.6.3 Single-Band 20 Watt RFA

The single-band 20 Watt RFA user interface consists of various LED's, power, communications and RF connectors. The RFA user interface is shown in Figure 2-37 and described in Table 2-27.

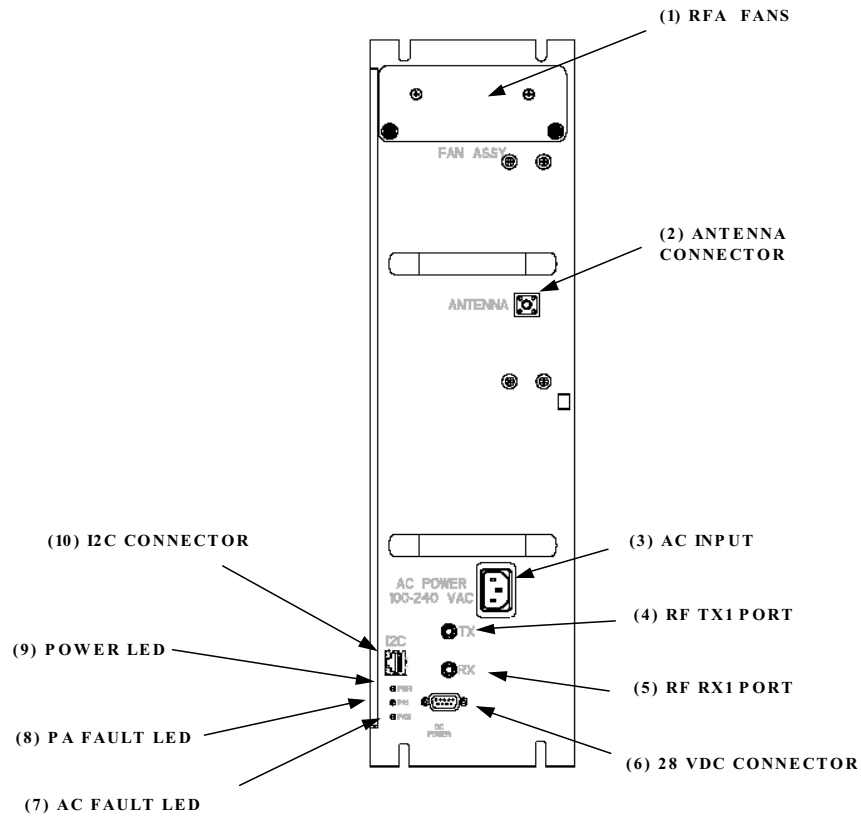


Figure 2-37. Single-Band 20 Watt RF Assembly Module Front Panel

Table 2-27. Single-Band 20 Watt RFA User Interface

REF No.	USER INTERFACE DESIGNATION	DEVICE	FUNCTIONAL DESCRIPTION
1	RFA Fans	Fan tray assembly	Front panel of RFA assembly
2	Antenna connector	SMA connector	Duplexed transmit and receive RF signals interface into antenna
3	AC Input	3-prong connector	AC power interface IEC-320
4	RF Tx1 Port	SMA connector	RF transmit input signal from RUC
5	RF Rx1 Port	SMA connector	RF receive output signal from duplexer
6	28 VDC Connector	DB-9 connector	Connects to fan assembly in AC configuration. Connects to DPEC when battery backup is used.
7	AC Fault LED	Single-colored LED (Red)	Status indicator turns red when redundant power supply of RFA has failed
8	PA Fault LED	Single-colored LED (Red)	Status indicator turns red when power amplifier has failed
9	Power LED	Single-colored LED (Green)	Status indicator turns green when RFA has power.
10	I2C	RJ-45 connector	I2C communications interface

7.7 Specifications

The specifications for the Digivance CXD are provided in Table 2-28. All specifications apply after a five minute warm-up period.

Table 2-28. Digivance CXD Specifications

PARAMETER	SPECIFICATION	REMARKS
Optical – Hub and RAN		
Fiber type	9/125, single-mode	
Number of fibers required		
Without WDM	2	
With WDM With CWDM	1 1 per 4 RANS	Requires CWDM optical transceivers and wavelength division multiplexers (WDM) which are accessory items.
Optical transceiver type	SFP	
Forward and reverse path wavelength Standard range Extended range	1310nm 1550 nm	
Optical transmit power output Standard range Extended range	0 dBm 0 dBm	Typical
Optical receive input Standard range Extended range	-9 dBm -26 dBm	
Optical budget Standard range Extended range	9 dB 26 dB	Typical
Optical connectors	LC	Dual-connector
RF Forward Path		
800 MHz Fullband	869 to 894 MHz	15 MHz bandwidth selectable
800 MHz A''/A	869 to 880 MHz	
SMR 800 MHz	851 to 866 MHz	
SMR 800 MHz Upper Band	862 to 869 MHz	
SMR 900 MHz	935 to 940 MHz	
1900 MHz Lowerband	1930 to 1965 MHz	15 MHz bandwidth selectable
1900 MHz Upperband	1965 to 1995 MHz	15 MHz bandwidth selectable
Intermodulation	-60 dBc	At remote output, two tone
Spurious	-60 dBc	
RF gain	10 dB	

continued

Table 2-28. Digivance CXD Specifications, continued

PARAMETER	SPECIFICATION	REMARKS
Gain flatness Band flatness Channel flatness	± 2.0 dB across freq. Range ± 1 dB variation across any 1.25 MHz channel	
Gain Variation	± 3 dB	Over frequency, temperature, and unit-to-unit.
Peak to Average Ratio	10 dB	
Propagation Delay	12 microseconds forward path	Excludes fiber
Configurable propagation delay Range Delay step size	0 – 566 microseconds 13 nanosecond increments	Manual or automatic
Composite RF input signal level	-25 to +10 dBm	Per RF band, non-duplexed
Composite RF output power Cellular 10 MCPA SMR 10 Watt MCPA PCS 10 Watt MCPA PCS 20 Watt MCPA	6.5 Watts (+38 dBm) 3.2 Watts (+35 dBm) 6.5 Watts (+38 dBm) 12.5 Watts (+41 dBm)	Composite at antenna port. See Note 1 at end of table.
Performance merit functions TDMA/EDGE GSM iDEN CDMA	5% EVM 3.5° RMS SQE decrease < 1 dB 0.98 Rho factor	
RF Reverse Path		
800 MHz Fullband	824 to 849 MHz	15 MHz bandwidth selectable
800 MHz A''/A	824 to 835 MHz	
SMR 800 MHz	806 to 824 MHz	
SMR 800 MHz Upper Band	817 to 824 MHz	
SMR 900 MHz	896 to 901 MHz	
1900 MHz Lowerband	1850 to 1885 MHz	15 MHz bandwidth selectable
1900 MHz Upperband	1885 to 1915 MHz	15 MHz bandwidth selectable
Gain	-10 to +35 dB	
Gain flatness Band flatness Channel flatness	± 2.0 dB across freq. Range ± 1 dB variation across any 1.25 MHz channel	
Gain variation	± 3 dB	Over frequency, temperature, and unit-to-unit.
Propagation Delay	12 microseconds forward path	Excludes fiber
Configurable propagation delay Range Delay step size	0 – 566 microseconds 13 nanosecond increments	Manual or automatic

continued

Table 2-28. Digivance CXD Specifications, continued

PARAMETER	SPECIFICATION	REMARKS
Input IP3	-16 dBm	
Noise figure 800/850/900 MHz 1900 MHz	5 dB 6 dB	
Minimum RF output level	10 dBm -5 dBm	Absolute maximum Operational maximum
Automatic Gain Limiting (AGC) Range Maximum input signals	25 dB -38 dBm	Peak signal input
Reverse path VSWR	2.0:1	
Physical/Environmental/Electrical – Hub		
Dimensions (HxWxD)	78 x 24 x 24 Inches	Hub rack
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
Digital Chassis		
Dimensions (HxWxD)	7.0 x 19.0 x 7.9 Inches 7.0 x 17.1 x 7.9 Inches	Mounting flange Body
Color	Brushed aluminum	
Backplane connections	RJ-45	
Power Input	±48 VDC	Floating
Power Consumption Digital Chassis CPU STF2 RSC SIF	76.0 Watts 20.2 Watts 3.5 Watts 8.8 Watts 15.2 Watts	Typical Fans and 12 VDC P/S
RF Chassis		
Dimensions (HxWxD)	7.0 x 19.0 x 7.9 Inches 7.0 x 17.1 x 7.9 Inches	Mounting flange Body
Color	Brushed aluminum	

Continued

Table 2-28. Digivance CXD Specifications, continued

PARAMETER	SPECIFICATION	REMARKS
Backplane connections	RJ-45	
Power Input	±48 VDC	Floating
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
Base Station Interface Module (BIM)		
Dimensions (HxWxD)	1.75 x 19.0 x 7.1 Inches 1.75 x 17.1 x 7.1 Inches	Mounting flange Body
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
Hub Reference Module (HRM)		
Dimensions (HxWxD)	1.75 x 19.0 x 7.1 Inches 1.75 x 17.1 x 7.1 Inches	Mounting flange Body
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
Physical/Environmental/Electrical – RAN		
Dimensions (HxWxD)		
Standard RAN Cabinet	23 x 18 x 11 Inches	2.6 cubic feet
Extended RAN Cabinet	23 x 18 x 17 Inches	4.1 cubic feet
Weight		
CXD RAN Standard Cabinet	23 lbs.	Empty, no modules
CXD RAN Extended Cabinet	49 lbs.	Empty, no modules
Pole mount bracket	7 lbs.	Metal and wood pole brackets
Single-band 10 W RFA	24 lbs.	
Single-band 20 W RFA	27 lbs.	
Dual-band 10 W/10 W RFA	33 lbs.	
Color	Gray	

continued

Table 2-28. Digivance CXD Specifications, continued

PARAMETER	SPECIFICATION	REMARKS
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)	
Start-up 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 conduit	Internal diameter
Fiber optical cable ingress	¾-inch conduit	Internal diameter
Power input	100 to 260 VAC	47 to 63 Hz
Lightning protection	20 kA IEC 1000-4-5 8/20 microsecond waveform	
Battery backup options Internal – RFA Slot Assembly External	1 hour 2 hour	Takes one RFA slot Requires Extended RAN Cabinet
Battery Weight Internal – RFA Slot Assembly External	61 lbs. 140 lbs.	Two batteries and tray Two batteries
Power consumption	600 Watts	Two 10 W PA option
Reliability at 25°	MTBF 50,000	Excluding fan assemblies

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

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1 INTRODUCTION

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

2 NETWORKING OVERVIEW

A Digivance CXD network consists of several CPUs running the Linux operating system as shown in Figure 3-1 Network Architecture. The CPUs residing in the Digivance CXD Hub (called “Hub nodes”) are connected through a router to an existing LAN to effect SNMP status and control. The CPUs in the RAN’s (called “RAN nodes”) are connected to the LAN using WAN bridges in each SIF, which transmit packet data across a fiber back-haul from each RAN node to its corresponding Hub. All Digivance CXD nodes support telnet, ftp, and vnc by default.

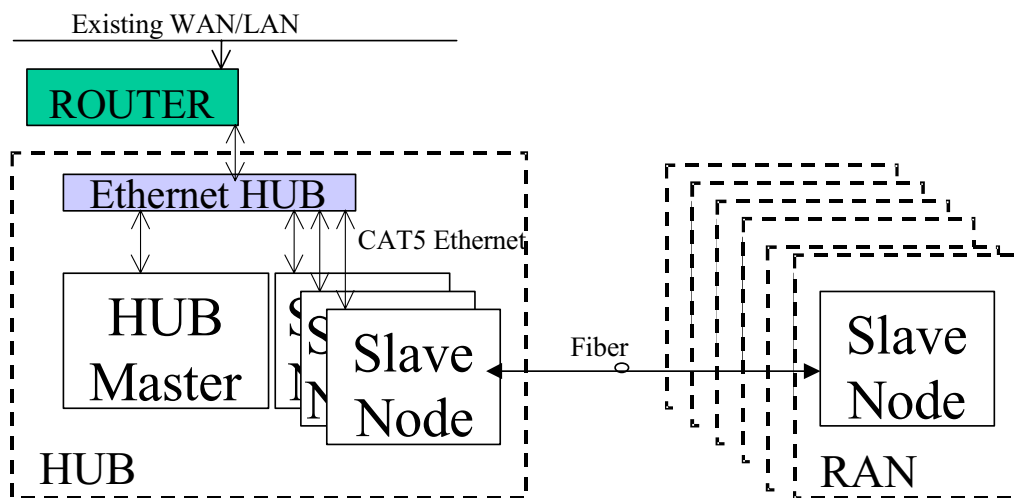


Figure 3-1. Network Architecture

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

3 NODE IDENTIFICATION SCHEMES

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

4 IDENTIFICATION USING THE NETWORK IP RECEIVER/SENDER SYSTEM

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

5 HUB EQUIPMENT IDENTIFICATIONS

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

Table 3-1. HUB Rack Numbering

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

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

- Hub Racks are numbered sequentially, Rack1, Rack2, etc, or by serial number.
- Chassis in Hub racks are numbered by 'U' number. For example, the lowest RF chassis shown in Table 3-1 would be numbered U12.
- BIMs in racks are numbered by 'U' number. For example, the lowest BIM shown in Table 3-1 Would be numbered U8.
- Power Attenuators are located at the top of the Hub rack or mounted to a wall.
- WSP Base stations should be given unique Tenant Name and BTS ID designations.
- Each base station sector is cabled to a separate attenuator and BIM unit in the Hub rack.
- Ensure that RF cables from the BIM forward output ports are connected to FBHDC modules in its related HUB RF chassis (not used if BTS is directly cabled to FBHDC)
- 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.

- Ensure that FBHDC modules are connected to FSC modules. (See Hub Installation and Maintenance Manual for details)
- An RF chassis in a Hub rack contains enough slots for 2 sets of tenant RF equipment, where a set of tenant RF equipment consists of one FSC, one HUC and up to two FBHDC's. A set of tenant equipment in an RF chassis is installed in a particular manner, from bottom to top, the order of modules is HUC, 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 3-2. RF Chassis Configuration for more details.

Table 3-2. 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

6 ASSIGNING TENANTS

6.1 Understanding Tenant MIB Indexing

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

Note: The Digivance CXD system can support up to 96 unique base station sectors per Hubmaster CPU.

6.2 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 CXD system. In order to create a new tenant in the Digivance CXD 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 11.1) 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 "UnconfiguredX", where X is 1-96. Also, it can be seen that the CPU Rack and Chassis IDs are filled in and the BIM I2C Bus/Slot information is filled in.

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).

6.2.1 Setting the Tenant Name

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

transceptBtsConnectionTable.transceptBtsConnectionTenantName.

6.2.2 Setting the BTS ID

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

transceptBtsConnectionTable.transceptBtsConnectionBTSID.

6.2.3 Setting the BTS Sector

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

transceptBtsConnectionTable.transceptBtsConnectionBTSSector.

6.2.4 Setting the Tenant Band

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

No Band (0) - no band selected, will not result in a configured tenant

US1900A (1) - PCS band A

US1900B (2) - PCS band B

US1900C (3) - PCS band C

US1900D (4) - PCS band D
 US1900E (5) - PCS band E
 US1900F (6) - PCS band F
 US800AAPP (7) - Cellular A and A" bands
 US800BBP (8) - Cellular B and B' bands
 US800AP (9) - Cellular A' band
 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

6.2.5 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

6.2.6 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.

6.2.7 Clearing tenants

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

transceptBtsConnectionTable.transceptBtsConnectionClear

6.2.8 HUC Invalid Config

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

transceptBtsConnectionTable.transceptBtsConnectionHucInvalidConnection.

6.2.9 Composite Mode

The Digivance CXD 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 3-3. Output Signal Strengths

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

6.2.10 Power Attenuator IDs

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

transceptBtsControlParamsTable.transceptBtsControlParamsPowerAttenXLoc, where X = 1 or 2.

6.3 Pathtrace Format

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

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

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

6.3.1 Pathtrace Creation

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

6.3.2 Pathtrace Forward Transmission

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

6.3.3 Pathtrace Forward Reception

In the forward path, the SIF modules in the Hub that are connected to the FSC outputs, as well as the SIF's in the simulcasted RAN's, 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 MIB for use by tenant processing and other higher-level processes.

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

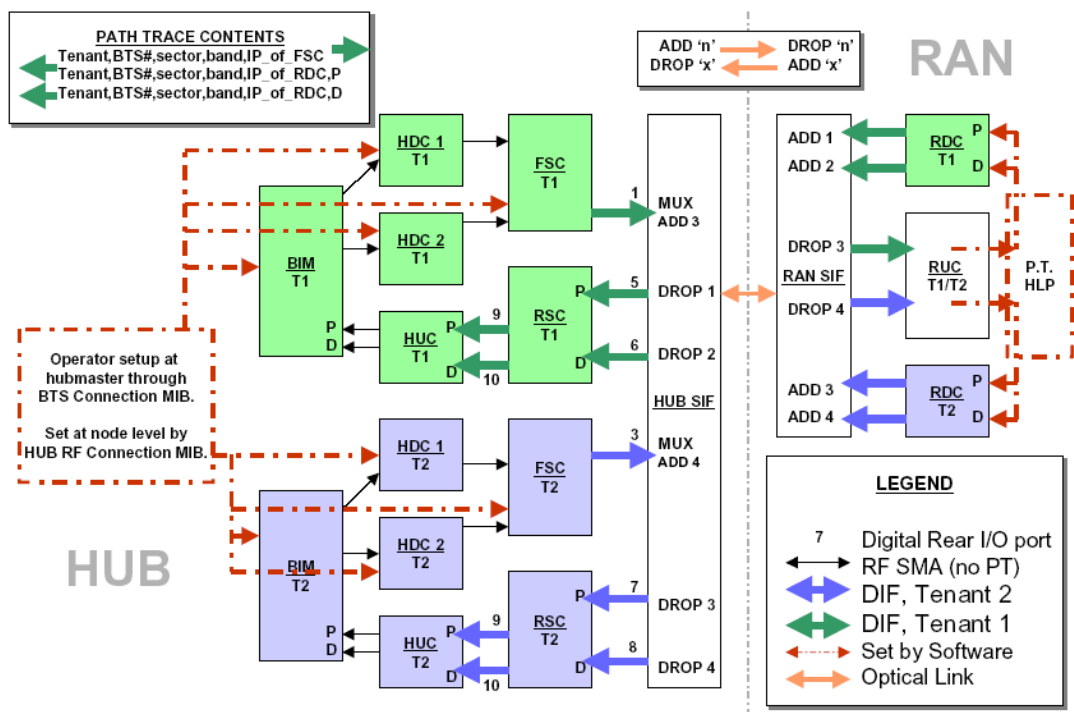


Figure 3-2. Tracing Pathtrace, Two Tenants

6.3.4 Pathtrace Reverse Transmission

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

The RDC HCP creates 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.

6.3.5 Pathtrace Reverse Reception

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

In the Hub, the RSC module receives the pathtrace strings from several RDC's into its FPGA from its DIF input connection. The RSC HCP reports the received input pathtrace strings in its MIB for use by higher-level processes, as described in sections below. The RSC has the added responsibility of determining the "majority inputs" to determine the most-prevalent input pathtrace based on Tenant ID sub-strings. When the majority input is discovered, the RSC will parse the Tenant ID from one of the majority inputs, append its own CPU IP Address, and transmit the newly created pathtrace string to its two outputs (primary/diversity).

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.

6.3.6 Pathtrace Detection/Reporting

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

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

On the 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 MIB's on each node with the appropriate Tenant IDs and indices that are used on that node. The Equipment Process then acts as the middle-level interface to the tenant hardware, reporting status of all the hardware in the Status Table of the Equipment MIB and allowing hardware configurations to occur via the Control Table of the Equipment MIB. Tenant processing in the 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.

7 TENANT CONFIGURATION

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

7.1 Setting Protocol

transceptTenantOAMTable.transceptTenantProtocol

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

7.2 Setting Channels

transceptTenantOAMTable.transceptTenantChannelXVal, where X = 1-8

Each Tenant sector in the Digivance CXD system can support from 1-4 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.

7.3 Setting Hub Measured Forward Gain

transceptTenantOAMTable.transceptTenantHubMeasuredForwardGain

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

7.4 Setting RAN Measured Forward Gain

transceptTenantOAMTable.transceptTenantRanXMeasuredForwardGain, where X = 1-8

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

7.5 Setting FSC Gain

transceptTenantMoreControlsTable.transceptTenantMoreControlsFscOutputGain

and

transceptTenantMoreControlsTable.transceptTenantMoreControlsFscOutputGainOverride

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

7.6 Setting RAN Forward Gain Offset

transceptTenantOAMTable.transceptTenantRanForwardGainOffsetX, where X = 1-8

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

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

7.7 Setting Reverse Gain

transceptTenantOAMTable.transceptTenantReverseGain

The Reverse Gain parameter in the Tenant OAM MIB allows the Reverse Gain Target to be set. This value sets the gain for the entire reverse path. The valid range of values for this parameter 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.

7.8 Setting Reverse Cable Loss

transceptTenantOAMTable.transceptTenantReverseCableLoss

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

7.9 Using Tenant Reset

transceptTenantOAMTable.transceptTenantReset

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

7.10 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 parameters in the Tenant MIB. These MIB fields are enumerated types with values "Enabled" = 0, and "Disabled" = 1. The reason for the inverse boolean logic is so that the desired default values are set to be zero, which is the MIB default value.

7.11 Using Tenant Mode

transceptTenantOAMTable.transceptTenantMode

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

7.12 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 parameters in the Tenant OAM MIB. These MIB fields are enumerated types with values "Enabled" = 0 and "Disabled" = 1. The reason for the inverse boolean logic is so that the desired default values are set to be zero, which is the MIB default value.

7.13 Setting Forward / Reverse Delay Skew

transceptTenantOAMTable.transceptTenantForwardSkew

and

transceptTenantOAMTable.transceptTenantReverseSkew

The delay skew used in the Forward/Reverse Delay Compensation processes can be adjusted using the associated Tenant OAM MIB parameters.

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

7.14 Forward/Reverse Target Delay

transceptTenantTargetDelayTable.transceptTenantForwardTargetDelay

and

transceptTenantTargetDelayTable.transceptTenantReverseTargetDelay

The Forward/Reverse Target delays can be adjusted using the Tenant Forward/Reverse Target Delay entries in the Tenant OAM MIB. The valid range of values for the Forward/Reverse target Delay is 12,000 to 150,000 ns with a default of 100,000 ns.

7.15 Enabling / Disabling RAN slots

transceptTenantOAMTable.transceptTenantRanDisableX, where X = 1-8

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

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

7.16 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.

7.17 Target Simulcast Degree

In order for the Digivance CXD 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 parameter. This MIB parameter accepts values ranging from 1-8, the range of simulcasting supported in Digivance CXD on a per sector basis.

7.18 Module Attenuators

In order to be consistent with all other configuration parameters in the system, and to ensure that configuration data is properly managed, the Tenant OAM MIB contains several parameters to allow the configuration of tenant module attenuators. When configured in the Tenant OAM MIB, tenant processing will push these attenuators 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.

8 MANAGING THE TENANT OAM ADDRESS AND HOSTNAME TABLES

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

8.1 RAN Ordering

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

Tenant processing uses a least-recently-used scheme to determine the RAN ID to assign to newly discovered 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 parameters, such as:

TenantRanDisableX, TenantRanXForwardMeasuredGain

and

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

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

8.2 Bracketing of Lost RANs

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

8.3 Clearing of RAN's

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

9 HUB NODE ACCESS/MANAGEMENT

9.1 Managing Hub Nodes

The Hub in a Digivance CXD network consists of several racks and chassis, which translate to several CPUs per HUB. Since these CPUs all reside at a single geographical location, it is necessary to establish a relationship of each CPU to its rack and chassis location such that field service personnel can be deployed to the correct location within the Hub when the need arises.

There can be many CPUs at a single Hub Site within the many racks and chassis, but there is no way to correlate an IP address to its physical rack/chassis location automatically. Therefore, a convention for identifying racks and chassis needs to be established. At installation time, each hostname, as written on the front tag of each CPU, must be recorded in conjunction with its physical location. This information is used when the operator fills in the Hub Node MIB, which is discussed in detail below. Digivance CXD Hub naming conventions are also discussed below.

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

9.2 Identification using the Network IP Receiver/Sender (NIPR/S)

The Digivance CXD 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 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 3-3.

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

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

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

9.3 Accessing Nodes Locally

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

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

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

9.4 Accessing Nodes via TCP/IP

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

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

9.5 Using a Third Party Network Management System with Digivance CXD

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

- Auto-polling
- The NMS must regularly poll all nodes for MIB entry updates.
- The NMS must regularly search for new nodes on its network.
- Graphical User Interface for data display and manipulation
- At a minimum, a MIB browser capable of SNMP level 2 sets and gets, coupled with a node map generator, would suffice.
- Ability to output poll data to a database for customizable GUI operations such as user accounts and data sorting is strongly recommended.
- Trouble ticket generation
- The Digivance CXD system outputs a wealth of raw event information. It is up to the NMS to determine what alarms are generated, and how to dispatch resources to rectify the situation.
- 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 Element Manager System (EMS) may be used to control and monitor the system.

10 CONFIGURING THE HUBMASTER NODE

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

- Network Timing Protocol Daemon (/usr/sbin/ntpd), synchronous with GPS input.
- Dynamic Host Configuration Protocol server (/usr/sbin/dhcpd3).

- Domain Name Server (/usr/sbin/named).
- Node IP Receiver/Sender (/usr/sbin/niprs) server-side properties discussed in Section 9.2.
- Digivance CXD Tenant processing (/usr/bin/tenantscan and /usr/bin/tenant).

10.1 Utilizing The Configure-Hubmaster Script

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

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

10.1.1 IP Address / Netmask

At the IP prompt, enter the static IP address that has been assigned to this 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 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 system.

10.1.2 DHCP Address Range

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

10.1.3 Default Gateway / Router

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

10.1.4 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, which is suggested to be changed to something more descriptive in the target network. At a minimum, numbering the

domains serially will achieve the desired result (i.e. Digivance CXD, Digivance CXD-4XD-G22, etc.).

10.1.5 DNS Forwarding

The script will prompt “Enter a list of upstream DNS servers, one per line: (control-d when done)” to set up DNS forwarding. It is expecting as input the IP address of each Domain Name Server that the 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.

10.1.6 NTP Service

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

10.1.7 SNMP Trap Sinks

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

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

10.2 Using Dynamic Host Configuration Protocol with Digivance CXD

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

10.2.1 Using The Provided Hubmaster DHCP

The Digivance CXD 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.

10.2.2 Incorporating Existing LAN DHCP

Using a pre-existing LAN DHCP server is ideal when the Digivance CXD 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:

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

As the 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 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.

10.2.3 Using Domain Name Service With Digivance CXD

The DNS offers a way to represent nodes using hostnames instead of IP addresses. This is an important relationship when using DHCP, since the hostnames are more likely to be static than their associated IP addresses. The Digivance CXD 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 DNS.

10.2.4 Using The HUBMASTER DNS

The Digivance CXD 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.

10.2.5 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.

11 CONFIGURING THE HUB “SLAVE” AND RAN NODES

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

11.1 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:

11.1.1 Site ID

transceptHubNodeTable.transceptHubNodeSiteID

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

11.1.2 CPU Rack ID

transceptHubNodeTable.transceptHubNodeCPURackID

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

11.1.3 CPU Chassis ID

transceptHubNodeTable.transceptHubNodeCPUChassisID

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.

11.1.4 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 system software. Changing hostnames on Digivance CXD nodes is not recommended, but can be accomplished by logging into the target node.

11.1.5 IP Address

transceptHubNodeTable.transceptHubNodeIPAddress

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

11.1.6 Clean

transceptHubNodeTable.transceptHubNodeClean

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

11.1.7 Setting the RF Rack/Chassis ID

transceptHubNodeRfTable.transceptHubNodeRfRackID

and

transceptHubNodeRfTable.transceptHubNodeRfChassisID

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

11.1.8 Setting The GPS Coordinates (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 system contains a GPS receiver, these MIB fields will not be used for Hub Slave nodes. The Digivance CXD 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.

11.2 Managing the RAN Node MIB

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

11.2.1 IP Address

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

11.2.2 Hostname

transceptRanNodeTable.transceptRanNodeHostname

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

11.2.3 Pole Number

transceptRanNodeTable.transceptRanNodePoleNumber

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

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

11.2.4 Site ID

transceptRanNodeTable.transceptRanNodeSiteID

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

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

11.2.5 RucXPaY Connection

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

These entries manually record the RF connection path between the RAN UpConverter's 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.

11.2.6 RdcZ 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

11.2.7 Invalid

transceptRanNodeExtTable.transceptRanNodeExtInvalid

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

11.2.8 Clean

transceptRanNodeExtTable.transceptRanNodeExtClean

This entry resides in the expansion MIB table of the RAN Node MIB. The RAN Node MIB keeps a history of every RAN ever seen by the 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 re-appear within seconds, even if it is cleared.

11.2.9 RAN Disable

transceptRanNodeDisableTable.transceptRanNodeDisableRanState

This entry in the RAN Node MIB allows a given RAN to have all of its PAs disabled(*). By setting this field to "disabled", the Digivance CXD 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.

11.2.10 Setting The GPS Coordinates

transceptRanNodeGpsCoordTable.transceptRanNodeGpsLongitude

and

transceptRanNodeGpsCoordTable.transceptRanNodeGpsLatitude

For cases where a GPS receiver is not present on a given node and it is desired to manually enter the GPS coordinates, the RAN Node MIB contains two MIB fields to configure the GPS longitude and latitude settings. The Digivance CXD software (Hub Config Process) checks for the presence of a GPS on the RAN nodes - if the GPS is present on a given node, then the GPS longitude/latitude values for that node will be automatically populated from that RAN's Network Node MIB. If the GPS is not present, then the 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.

SECTION 4: BTS INTEGRATION

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1 BTS VALIDATION

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

2 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 MIBs, values are represented in 0.1 dB increments (e.g. -100 indicates -10.0 dBm).

2.1 Forward Path Balancing

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

2.1.1 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 4-1.

- 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

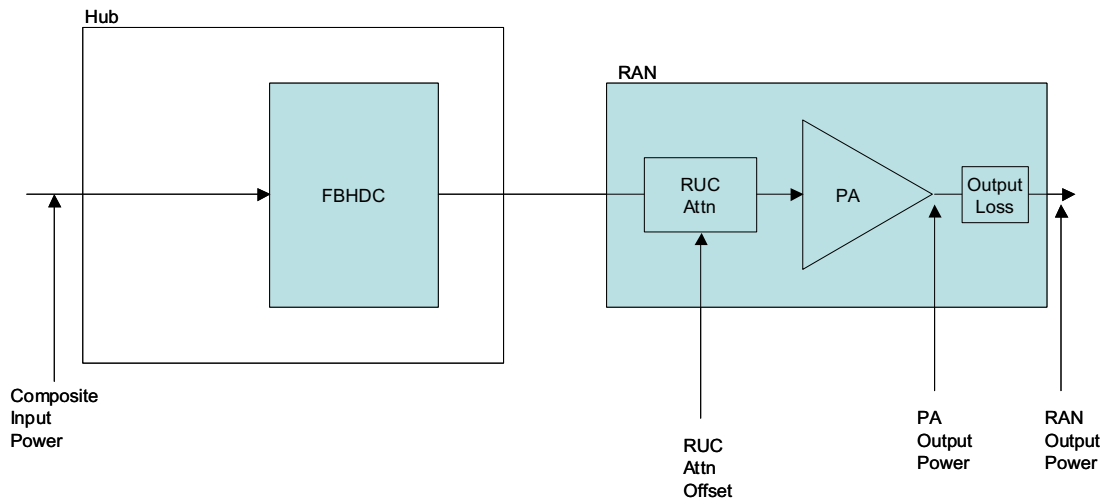


Figure 4-1. FBHDC Direct Cable Balancing

Table 4-1 shows the recommended power levels and gains for the various CXD bands.

Table 4-1. Forward Setting

BAND	COMPOSITE INPUT POWER	PA OUTPUT POWER	RAN OUTPUT POWER	FORWARD GAIN
SMR-A	-7 dBm	+37 dBm	+35 dBm	+42 dB
SMR-B	-7 dBm	+37 dBm	+35 dBm	+42 dB
Cellular	-4 dBm	+40dBm	+38 dBm	+42 dB
PCS	-4 dBm	+43 dBm	+41 dBm	+45 dB

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 a negative offset increases it.

2.1.2 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 4-2.

- 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 2dB diplexer/cable loss
- 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

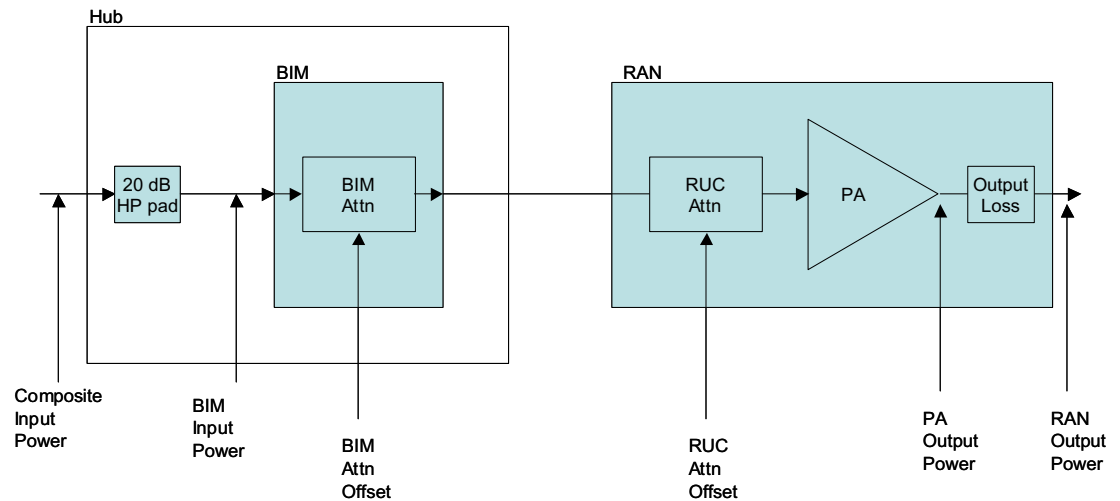


Figure 4-2. BIM Forward Balance

Table 4-2 shows the recommended power levels and gains for the various CXD bands when interfaced to the 20 dB Attenuator and the BIM.

Table 4-2. Recommended Forward Balance

BAND	COMPOSITE INPUT LEVEL	PA OUTPUT POWER	RAN OUTPUT POWER	FORWARD GAIN
SMR-A	44 dBm	+37 dBm	+35 dBm	-9 dB
SMR-B	44 dBm	+37 dBm	+35 dBm	-9 dB
Cellular	47 dBm	+40dBm	+38 dBm	-9 dB
PCS	47 dBm	+43 dBm	+41 dBm	-6 dB

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.

2.2 Reverse Path Balancing

The reverse gain indicates how much gain the Digivance CXD will give to a reverse path signal before presenting it to the base station (e.g. a -100 dBm signal at the RAN input will be -90 at the input to the BTS when Reverse Gain is set to 10 dB). The reverse gain settings are shown in Table 4-3.

Table 4-3. 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 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.

2.3 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.

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SECTION 5: SOFTWARE UPDATES

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1 SOFTWARE RELEASE DELIVERABLE

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-3.2.0-upgrade* would be used to upgrade a target Hub or RAN CPU to version 3.1.0. When invoked, the upgrade executable will automatically take the appropriate actions to upgrade the target CPU.

2 RELEASE NOTES

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

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

Also included are the steps needed to complete the upgrade.

3 UPGRADING 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. Some important notes regarding this type of upgrade:

3.1 Preliminary Steps

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

- The Hub Master should be the final CPU upgraded in the network to ensure that any new network-level functions are managed and supported properly.
- It is assumed that a network administrator will be performing the upgrade.
- Upgrading an operational system will interrupt service, so upgrades should be planned during the maintenance window.
- An upgrade of a test CPU should be attempted prior to upgrading an entire system or set of systems.
- For upgrade verification purposes, note the PA power, RUC attenuator values, and module pathtrace values (see the `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.

3.2 Upgrade Steps

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

4 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:

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

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

When evaluating the process list, it is important to be sure that the process 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.

5 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 uninstall/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.

6 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.*

7 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:

7.1 Backup

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

Run the backup script:

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

7.2 Restore

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

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

Run the restore script:

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

Reboot by entering: *sudo reboot*

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

7.3 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

8 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.*

9 MIB EXTRACTION

The following procedure outlines the process for extracting the Digivance SNMP Agent MIBs needed to update the NMS after a software update:

- Once the software upgrade is complete, FTP to one of the updated CPUs, logging in as username = operator and password = operate.
- Change to the MIB directory by entering: ***cd /usr/share/mibs/transcept/***
- Extract/get all of the MIB text files located there by entering: ***mget TRANSCEPT-*.txt***, answering yes to each prompt.
- Extracting the 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 transcept.tar.gz***.

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SECTION 6: AUTONOMOUS SOFTWARE FUNCTIONALITY

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1 INTRODUCTION

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

2 FORWARD GAIN MANAGEMENT

The Digivance CXD 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.

3 REVERSE AUTOMATIC GAIN CONTROL

The Digivance CXD 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 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).

5 REVERSE DELAY MANAGEMENT

Reverse Delay Management (RDM) is a software function that is part of Tenant Processing and whose responsibility is to equalize the 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).

6 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.

7 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.

7.1 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.

7.2 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.

7.3 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.

8 PA OVERPOWER PROTECTION

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

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

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.

9 HUB OVERPOWER PROTECTION

Hub Overpower Protection (HOP) is a software function to control the output levels of the FSC. HOP periodically measures the FSC output power. If the power exceeds a target level (-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.

SECTION 7: MIB STRUCTURE

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1 MIB RELATIONSHIPS

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

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

Figure 7-1 displays the MIB's used in the Digivance CXD system, which node* type(s) each MIB is used in, and how the MIB's are related to each other. The sections that follow will describe each of the MIB's and how they are used in the Digivance CXD system.

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

MIB RELATIONSHIPS

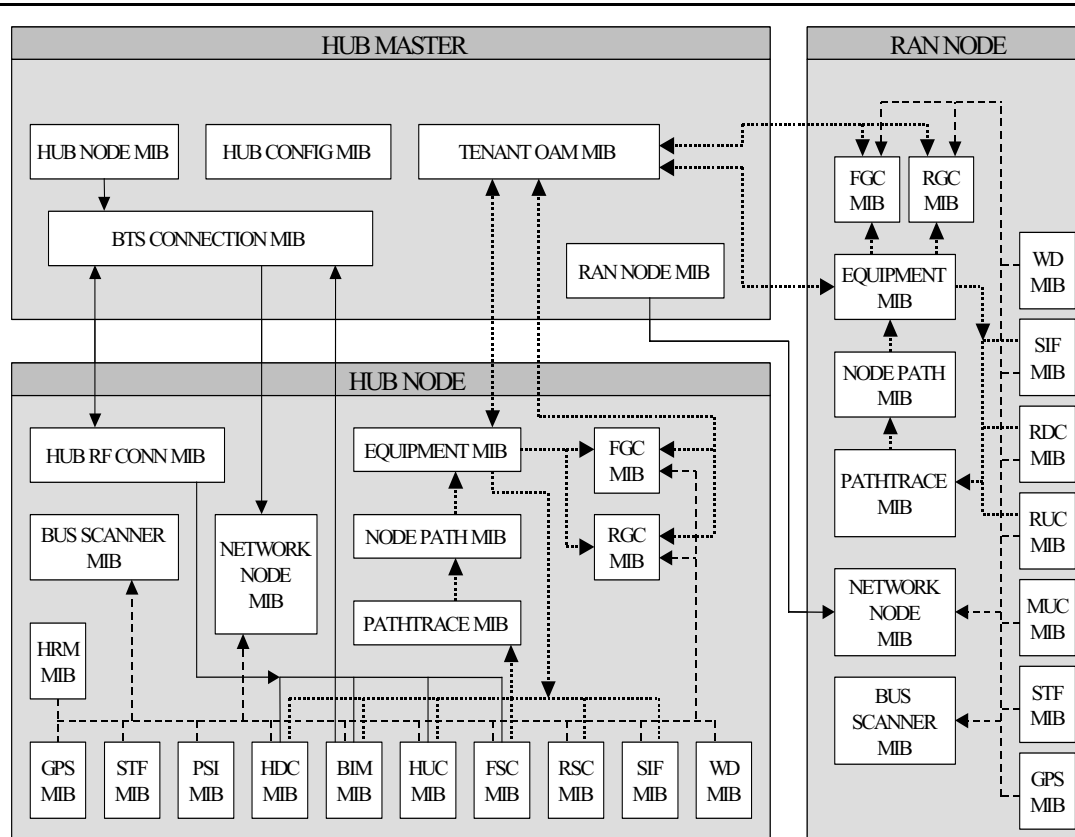


Figure 7-1. MIB Relationships

MIB's described in Figure 7-1 and in the sections below provide a general overview of the MIB's used in the Digivance CXD system. MIB's may be added, deleted or changed as the product is developed and as enhancements are added.

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

2 HARDWARE RELATIONSHIPS

In Figure 7-1, the dashed lines seen in the Hub and RAN Nodes show the relationships among MIB's associated with specific hardware modules.

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

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

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

2.1 Hub/RAN Connection Relationships:

In Figure 7-1, the solid lines between the Hubmaster and Hub/RAN nodes illustrate Hub/RAN connection relationships.

The Hubmaster contains a process called the Hub/RAN Config Process that is responsible for managing the connections between the Hubmaster and the other nodes in the network. This process uses the Hub Node MIB and RAN Node MIB to manage these connections. The Hub/RAN Node MIB's allow specific information about the Hub/RAN nodes to be configured. This includes such things as Site ID, Pole ID, and RAN hardware connections. The Hub/RAN Config Process will push the information configured in these MIB's down to the Network Node MIB at each node. Refer to Section 3 Network and System Installation and Setup for a more in-depth explanation of how to use these MIB's.

The Hub/RAN Config Process is also responsible for preparing the Hubmaster to have tenant relationships established. This process uses the information set in the Hub Node MIB and BTS Connection MIB to configure the tenant relationships. Information that is provided in the BTS Connection MIB as part of Tenant Setup will be pushed down to the Hub RF Connection MIB in the Hub Nodes. Refer to Section 3 Network and System Installation and Setup for a more in-depth explanation of how these MIB's are used.

2.2 Tenant Relationships:

In Figure 7-1, 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, then a Tenant process is kicked off to manage that new tenant. This tenant process uses the Tenant OAM MIB in the Hubmaster node to allow tenant specific parameters to be configured. These parameters allow the setting of frequency, gain, and delay values as well as any other tenant specific information. When these values are set, the Tenant process pushes this information to the Equipment MIB at the appropriate node(s).

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

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

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

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

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

Tenant processes in the 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 MIB's to read power values and set attenuator values as part of gain control. The results of the gain control processes are then reported into the Forward/Reverse Gain MIB's.

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1 WARRANTY/SOFTWARE

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

2 SOFTWARE SERVICE AGREEMENT

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

3 REPAIR/EXCHANGE POLICY

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

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

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

4 REPAIR CHARGES

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

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

5 REPLACEMENT/SPARE PRODUCTS

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

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

6 RETURNED MATERIAL

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

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

7 CUSTOMER INFORMATION AND ASSISTANCE

PHONE:

EUROPE

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

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

EUROPEAN TOLL FREE NUMBERS

Germany: 0180 2232923

UK: 0800 960236

Spain: 900 983291

France: 0800 914032

Italy: 0800 782374

U.S.A. OR CANADA

Sales: 1-800-366-3891 Extension 73000

Technical Assistance: 1-800-366-3891

└ Connectivity Extension 73475

└ Wireless Extension 73476

ASIA/PACIFIC

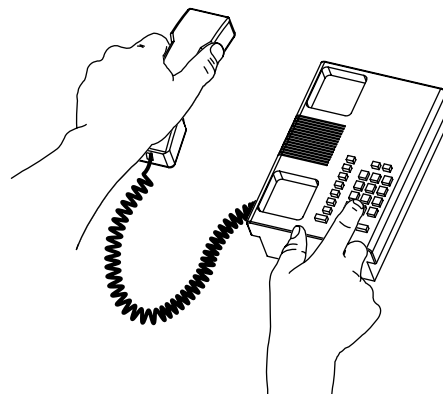
Sales Administration: +65-6294-9948

Technical Assistance: +65-6393-0739

ELSEWHERE

Sales Administration: +1-952-938-8080

Technical Assistance: +1-952-917-3475

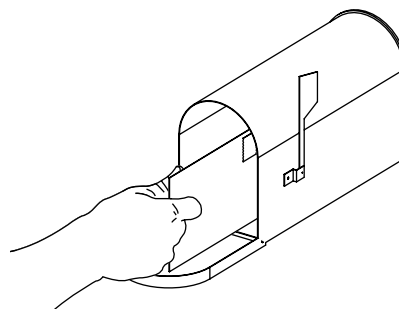


WRITE:

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

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

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



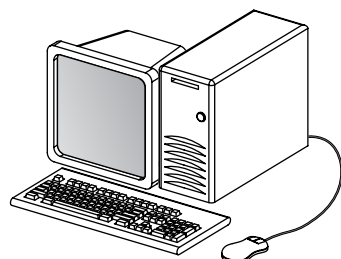
PRODUCT INFORMATION AND TECHNICAL ASSISTANCE:

connectivity.tac@adc.com

wireless.tac@adc.com

euro.tac@adc.com

asiapacific.tac@adc.com



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