System Release 7.17
ASTRO® 25
INTEGRATED VOICE AND DATA

HPD Remote Site Infrastructure

NOVEMBER 2016

MN003300A01-A

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Document History

Version	Description	Date
MN003300A01-A	Original release of the *HPD Remote Site Infrastructure* manual	November 2016

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About HPD Remote Site Infrastructure

This booklet provides an introduction to the High Performance Data (HPD) Remote Site subsystem, and describes each component, identifies the equipment configurations possible, and connections required for installation.

This booklet is intended to be used by technicians and system operators as a resource for understanding and installing an HPD remote site, after they have attended the Motorola Solutions formal HPD training. The booklet should be used with the ASTRO® 25 system documentation and *Standards and Guidelines for Communication Sites*.

What Is Covered in This Manual?

This booklet contains the following chapters:

- HPD Remote Site Description on page 21, provides a high-level description of the High Performance Data (HPD) remote site and the function it serves on your system.
- HPD Remote Site Theory of Operations on page 25, explains how the HPD remote site works in the context of your system.
- HPD Remote Site Installation on page 43, provides the installation procedures relating to the HPD remote site.
- HPD Remote Site Configuration on page 65, provides the configuration procedures relating to the HPD remote site.
- HPD Remote Site Optimization on page 71, provides the optimization procedures and recommended settings relating to the HPD remote site.
- HPD Remote Site Operation on page 73, details the tasks that you perform once the HPD equipment is installed and operational on your system.
- HPD Remote Site Maintenance on page 75, describes periodic maintenance procedures relating to the HPD remote site.
- HPD Remote Site Troubleshooting on page 77, provides the fault management and troubleshooting information relating to the HPD remote site.
- HPD Remote Site FRU/FRE Information on page 83, provides the Field Replaceable Units (FRUs) and Field Replaceable Entities (FREs) and includes replacement procedures applicable to the HPD remote site.
- HPD Remote Site Reference on page 85, contains supplemental reference information relating to the HPD remote site.

Helpful Background Information

Motorola Solutions offers various courses designed to assist in learning about the system. For information, go to http://www.motorolasolutions.com/training to view the current course offerings and technology paths.

Related Information

Related Information	Purpose
Standards and Guidelines for Communication Sites	Provides standards and guidelines that should be followed when setting up a Motorola Solutions communications site. This document may be purchased on CD **9880384V83** by calling the North America Parts Organization at 800-422-4210 (or the international number: 302-444-9842).
System Overview and Documentation	Provides an overview of the ASTRO® 25 new system features, documentation set, technical illustrations, and system-level disaster recovery that support the ASTRO® 25 radio communication system.
Dynamic System Resilience	Provides information necessary to understand, operate, maintain, and troubleshoot the Dynamic System Resilience (DSR) feature which may be implemented on your ASTRO® 25 system. This feature adds a geographically separate backup zone core to an existing zone core to protect against catastrophic zone core failures.
Motorola GGM 8000 Hardware User Guide *Motorola Network Router (MNR) S2500 Hardware User Guide*	Provides hardware installation, basic software configuration, and cabling instructions for the GGM 8000 gateway. Provides hardware installation, basic software configuration, and cabling instructions for the MNR S2500 router. These guides are available on the Motorola Online website. To access the guides, select **Resource Center → Product Information → Manuals → Network Infrastructure → Routers and Gateways**.

Chapter 1

HPD Remote Site Description

This chapter provides a high-level description of the High Performance Data (HPD) remote site and the function it serves on your system.

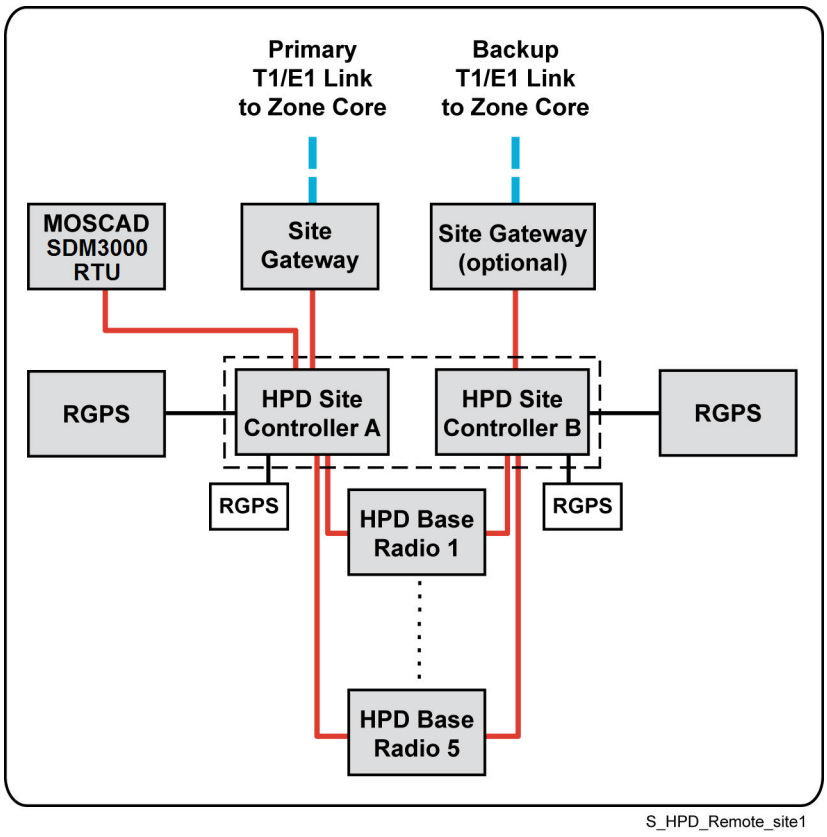
1.1 HPD Remote Site Overview

An High Performance Data (HPD) remote site provides the RF coverage for Mobile Subscriber Units using the HPD service. The site includes site control equipment, a number of RF channels, Radio Frequency Distribution System (RFDS), and optional site monitoring devices.

Figure 1: HPD Remote Site

The following diagram shows the typical configuration for an HPD remote site.

NOTICE: Ethernet links may be implemented from the HPD remote site to the master site. For more information, see the *Flexible Site and Ethernet Links* manual.



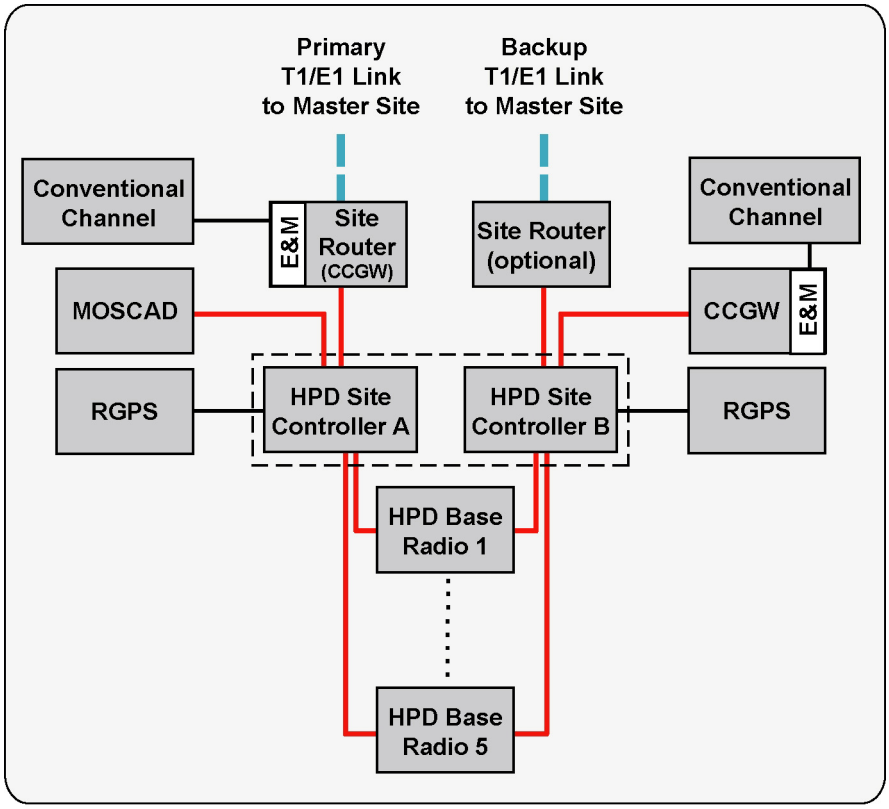
The HPD remote site consists of the following equipment:

- S2500 site router or GGM 8000 site gateway (redundant routers or gateways optional). For information, see the *System Routers S6000 and S2500 System Routers* and the *GGM 8000 System Gateways* manuals.
- HPD Site Controller (with redundant modules)
- HPD Base Radios (for 700 MHz and 800 MHz channels)

- MOSCAD Network Fault Management (NFM) site device manager (optional)

Additionally, the site allows IP-based analog conventional mutual aid channels to be colocated at the site. For this collocation, the site router must include an ST2513 4-wire E&M module (and DSP SIMM) to operate as a site gateway (analog conventional channel interface). Also, the GGM 8000 site gateway must include an analog/V.24 interface kit to operate as a site gateway (analog conventional channel interface). Up to two S2500s configured as site gateways (analog conventional channel interface) or two GGM 8000s configured as site gateways (analog conventional channel interface) can exist at an HPD remote site. An example of this type of system is shown in the following figure.

Figure 2: HPD Remote Site with Conventional Channels



The S2500 router may also connect with a channel bank to support circuit-based mutual aid at the site (if installed). If circuit-based mutual aid equipment is located at the site, then a 60-pin FlexWAN(v.35) connection can be made to a channel bank to support the circuit-based equipment.

1.1.1
Dynamic System Resilience (DSR)

Dynamic System Resilience (DSR) allows a system to continue to function without a loss of functionality on the failure or destruction of any controlling master site within a single or multi-zone by providing geographically redundant fixed network equipment. DSR also improves protection for major components by providing redundant components.

If a remote site is unable to establish contact with the Zone Controller at the primary zone core, the remote site establishes connectivity with the Zone Controller at the backup zone core. If a primary site link is down, a remote site uses the backup site link and traffic is routed to the primary zone core via the backup zone core.

If DSR is implemented on your system, see the *Dynamic System Resilience* manual for more information.

1.1.1.1

HPD Dynamic System Resilience (DSR) Configuration

If Dynamic System Resilience (DSR) is implemented on your system, see the following manuals for information on the High Performance Data (HPD) DSR configuration:

- *GCP 8000 Site Controller* manual
- *GTR 8000 Base Radio* manual
- *GTR 8000 Expandable Site Subsystem* manual

1.2

Trunking Subsystem (Tsub)

Concept definition.

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Chapter 2

HPD Remote Site Theory of Operations

This chapter explains how the High Performance Data (HPD) remote site works in the context of your system.

2.1 HPD Remote Site

The High Performance Data (HPD) remote site provides the RF interface to Mobile Subscriber Units in the region. The site includes an HPD Site Controller (HPD SC) with redundant modules to service registration requests, administer site operations, and handle inbound and outbound HPD traffic. One HPD SC module operates as the active HPD SC at the site, while the redundant module remains in standby mode.

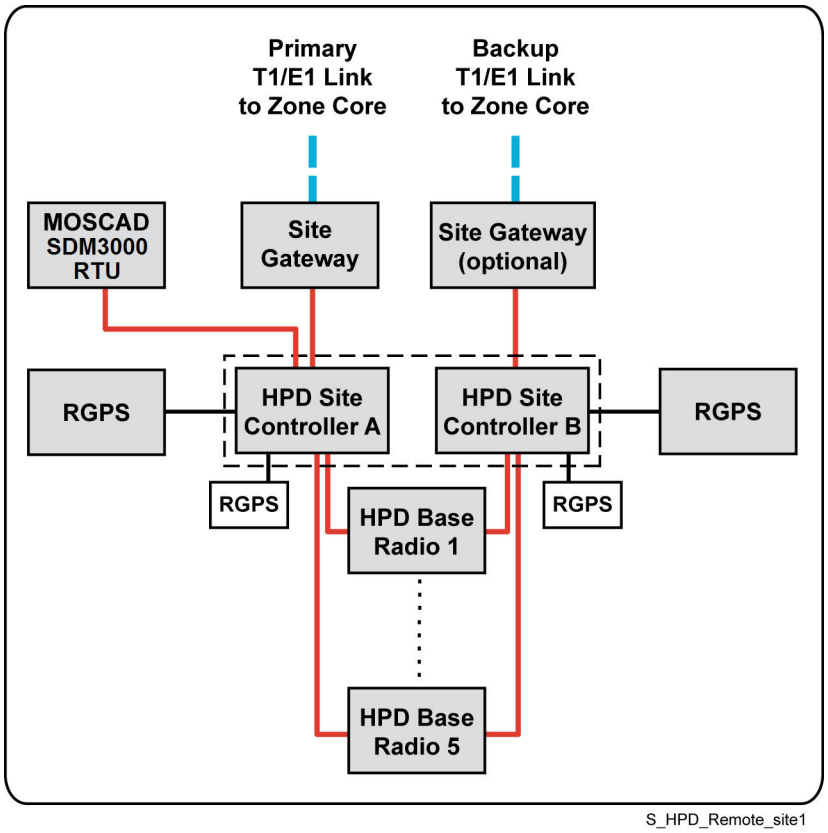
The site may include up to five HPD channels. Each channel at the site is implemented by a full-duplex Base Radio (BR) with HPD capability. These HPD BRs maintain periodic communication with the HPD SC for site control messaging and status updates. Registration requests/responses are routed between the HPD BRs and Zone Controller through the active HPD SC. HPD user data is routed between the HPD BRs and the HPD Radio Network Gateway (HPD RNG) in the zone through the HPD SC.

The HPD remote site is connected to the master site through the site router or site gateway on either a full or fractional T1/E1 link or an Ethernet link. A secondary site router or site gateway and site link can be added to the site for redundancy and high-availability of HPD services at the site. The site routers or site gateways and site links operate in an active/standby configuration.

The site configuration shown in the following figure may consist of the site routers or site gateways and any one of the following types of platforms.

- Standalone HPD Site Controller, standalone HPD BRs, and customer-supplied Radio Frequency Distribution System (RFDS)
- GTR 8000 Site Subsystem
- GTR 8000 Expandable Site Subsystem

Figure 3: HPD Remote Site



2.2 HPD Remote Site Router or Remote Site Gateway

The HPD site router (S2500) or site gateway (GGM 8000) is responsible for routing all traffic between the equipment at the HPD remote site and the Cooperative WAN Routing (CWR) system at the master site. The site router or site gateway can be connected to the master site using either T1, E1, fractional T1 (FT1), or fractional E1 (FE1) or an Ethernet link.

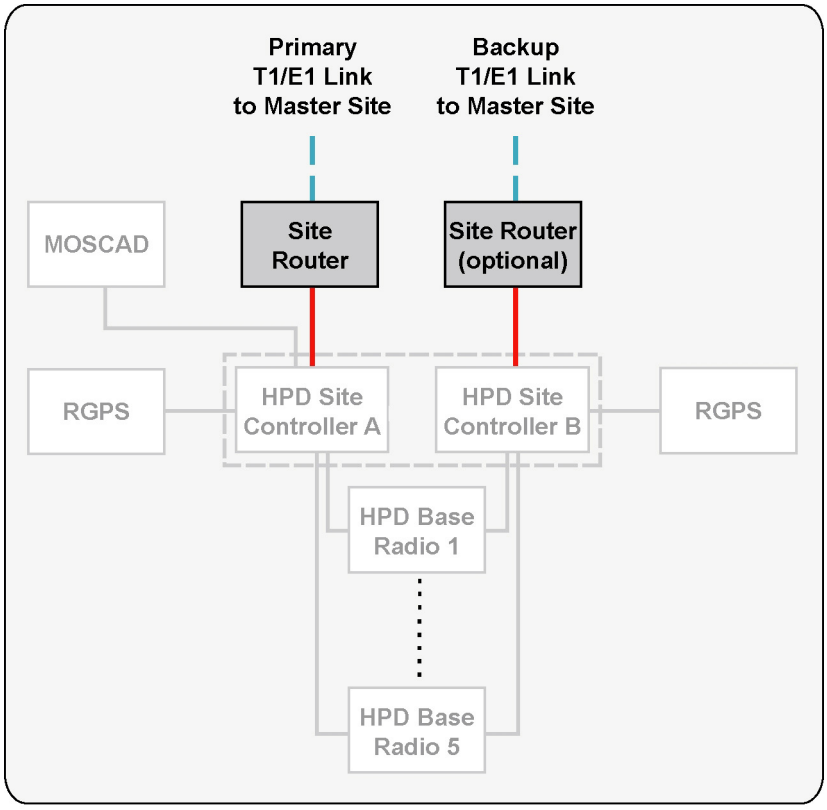
The HPD remote site is connected to the master site through the site router or site gateway on either a full or fractional T1/E1 link or an Ethernet link. If a T1/E1 link is used, the S2500 site router must be equipped with an ST2512 T1/E1 module. If an Ethernet link is used, the S2500 site router must be equipped with an ST2510 Ethernet module. For more information, see the *Flexible Site and InterZone Links* manual and the *S6000 and S2500 System Routers* manual.

NOTICE: The GGM 8000 site gateway is equipped with two T1/E1 ports and four Ethernet ports on the base system; no additional modules are required.

The HPD site router or site gateway sends all inbound traffic to core routers at the master site, which then forward the traffic to the next appropriate hop. For all outbound traffic received from the master site, the site router or site gateway forwards the traffic to the appropriate device on the site LAN.

Depending on the availability requirements for the site, an optional redundant site router or site gateway can be installed. Redundant site routers or site gateways operate in an active/standby configuration. Only one path is active at a time. If a failure occurs on the active path (or the primary Site Controller fails), then the system can revert to the standby path.

Figure 4: Redundant Site Routers



The MNR 2500 is used as the HPD site router. For more information, see the *System Routers – S6000 and S2500* manual.

The GGM 8000 is used as the site gateway. For more information, see the *System Gateways – GGM 8000* manual.

The cConfiguration, backup/restore, and fault management for the router or gateway can be performed through the Unified Network Configurator (UNC). The router or gateway is pre-configured for the system by Motorola Solutions before it is shipped from the factory.

2.3 HPD GCP 8000 Site Controller

The HPD Site Controller (HPD SC) is responsible for managing resources and HPD services at the HPD remote site.

The HPD SC provides the following functions at the site:

- Site and channel management
- Forwards registration and context activation requests
- Administers broadcasts
- Involves with inbound/outbound HPD traffic flow
- Time and frequency reference disciplining for the HPD Base Radios
- Monitors HPD BRs and Radio Frequency Distribution System (RFDS) equipment
- Alarm monitoring capabilities
- Interacts with a MOSCAD NFM site device manager (optional)

The HPD SC manages the state of HPD services available at the site. Under the direction of the Zone Controller (and depending on the network status), the HPD SC controls whether the site is in wide area mode or local mode. Channels at the HPD remote site are under the direction of the HPD SC. The HPD SC dictates the selection and assignment of channels, including home channel designation and channel loading features.

The HPD SC plays a role in registration, context activation, and IP bearer services. For registration events, the HPD SC is responsible for forwarding requests and responses between the HPD BRs and the Zone Controller. The HPD SC maintains its own database of active MSUs at the site. This database includes the channel assignment and registration status for each MSU operating at the site.

For context activation events, the HPD SC is involved with forwarding the context activation requests and responses between HPD BRs and the HPD RNG in the zone. In a similar fashion, the HPD SC is involved with forwarding HPD user data between the HPD BRs and the HPD RNG in the zone.

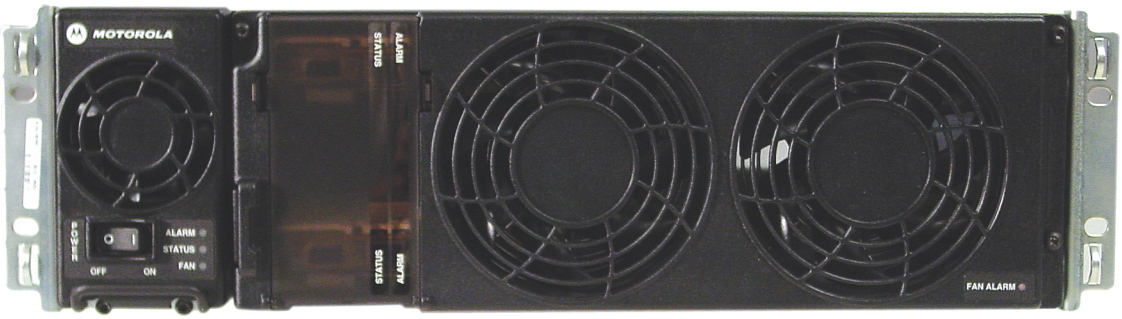
The HPD SC administers a number of different broadcasts to the MSU population. These broadcasts indicate important information for MSUs in the region. This information includes the status and home channel frequencies for adjacent sites, time and date, channel access, system identification, base station identifier, and channel information updates.

The HPD SC provides time synchronization and 20 MHz frequency reference to the HPD BRs at the site. This time and frequency are supplied to HPD BRs through the Ethernet link or over the backplane (if using a GTR 8000 Expandable Site Subsystem). The HPD SC includes a high-stability ovenized crystal oscillator which is trained by input from a Remote Global Navigation Satellite System (RGNSS) unit that provides a 1PPS signal. One RGNSS unit must be connected to each HPD SC module. Configuration/Service Software (CSS) indicates whether the GNSS capability is configured. The HPD SC sends status messages and alarms for the GNSS service to the Unified Event Manager (UEM).

The Ethernet service port on the HPD SC module mirrors all the other ports on the internal switch in the HPD SC.

The HPD SC hardware platform is the GCP 8000 SC. This SC chassis includes two redundant SC modules and a power supply. The SC modules are configured in an active/standby configuration. The two modules maintain communication with one another. Depending on the circumstances and the site configuration, a failure in the active module (or in the site control path of the active module) causes the standby SC module to activate and take over operations at the site. HPD services are interrupted for a short time during this switchover process. The HPD SC can receive auxiliary power from an HPD Base Radio, which allows resumed operation in the event of a power supply failure in the HPD SC.

Figure 5: GCP 8000 Site Controller



HPD_GCP_site_controller_front.jpg

The HPD SC monitors the status of HPD Base Radios and Radio Frequency Distribution System (RFDS) equipment at the site. If a BR is not acknowledging messages or is not responding to periodic pings, the HPD SC assumes that the HPD BR has failed. The HPD SC takes the failed HPD BR out of service. MSUs transit to other available channels at the site, according to the channel information received in Additional Channel Broadcasts.

The HPD SC can be connected with the power monitor and Receiver Multicouplers (RMCs) in the RFDS to monitor the transmit and receive paths. The HPD SC monitors the ratio of forward/reflected power indicated by the power monitor to determine whether the transmit antenna path is good or bad. On the receive line, the RMCs detect a failure and activate their alarm output and deactivate their presence detect output.

The active HPD SC monitors the status of these devices, and upon change of state, forwards the status and alarm information as LAN messages to MOSCAD NFM for processing. The MOSCAD NFM platform reports RFDS status and alarm information to the Unified Event Manager (UEM) for fault management monitoring. The MOSCAD NFM platform also informs affected Base Radios of any changes in alarm state so the BRs can take the appropriate action (bring themselves in or out of service).

The HPD SC also supports additional alarm inputs and outputs.

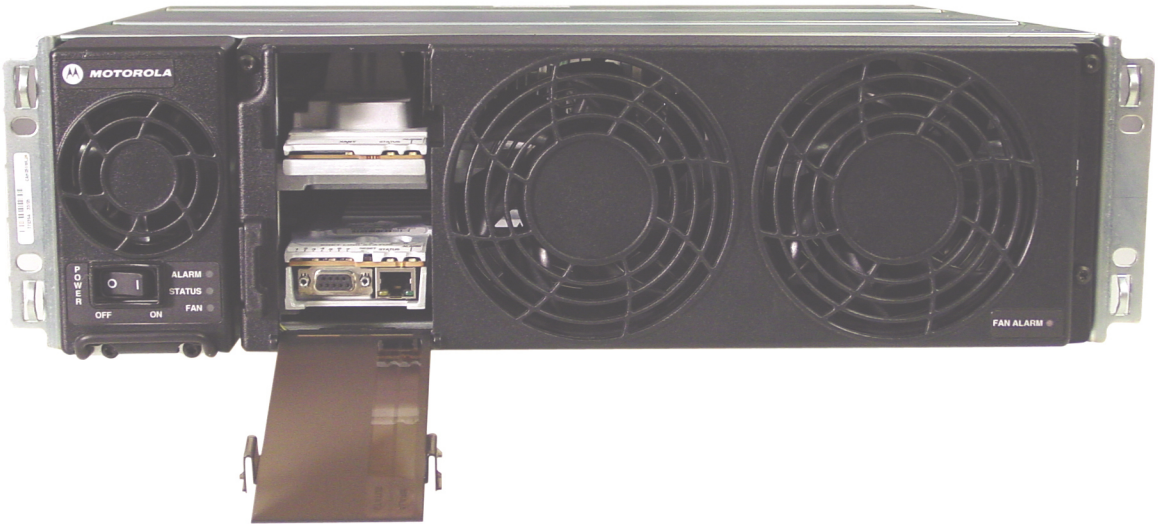
2.4 HPD GTR 8000 Base Radio

High Performance Data (HPD) Base Radios provide a full-duplex RF interface to HPD Mobile Subscriber Units. HPD Base Radios (HPD BRs) are available for 25 kHz HPD operation in the 700 MHz or 800 MHz bands. Up to five HPD BRs may be installed at a site. Each BR has an Ethernet connection to both HPD Site Controllers (HPD SCs) at the site.

The platform consists of a transceiver module, power amplifier module, power supply, and fan module. The transceiver module includes the functionality for the exciter, receiver, and station control. The BR software, configuration, and Network Management, as well as inbound and outbound traffic is handled through this transceiver module. On-board serial and Ethernet ports are located on this module for local servicing through Configuration/Service Software (CSS).

The power amplifier module amplifies the low-level modulated RF signal from the transceiver module and delivers the amplified signal on the path to the transmit antenna. The power supply module supports the transceiver and power amplifier modules, and can also provide auxiliary power to a connected SC or a receive multicoupler.

Figure 6: GTR 8000 Base Radio with the Alarm Door Opened



GTR8000_NonXS_BR_Front_DoorDown

The HPD BR uses Time Division Multiplexing (TDM) frames for random access channels, reserved access channels, and broadcast messages. All carriers in the system are synchronized by GNSS so that broadcasts are coordinated. The BR is able to schedule inbound/outbound traffic for half-duplex

MSUs so that outbound traffic intended for the MSU does not conflict with inbound random or reserved access traffic from the MSU.

The HPD BR uses Radio Link Adaptation (RLA) to provide high speed, reliability, and enhanced data performance when communicating traffic with MSUs. RLA uses adaptive modulation techniques with slower and more reliable modulation for control signaling and retries, and faster modulation methods when traffic is successfully being delivered between the BR and MSUs. The HPD BR also uses scrambling to improve the rejection of co-channel interference from other BRs in the system that are using the same frequency. For the receive path, the HPD BR is typically implemented with 2X receiver diversity. This receiver diversity enhances the inbound signals from the MSUs on the channel.

The GTR 8000 BR platform is used as the HPD BR. It is connected with both HPD SC modules at the site. The HPD BR receives external frequency reference discipline and network time synchronization from the active SC over the Ethernet link. In the event of losing the external time and frequency reference source, the HPD BR continues to maintain its own time and frequency stability to continue operations for a specified amount of time without degradation. After a time, operation continues with minimal degradation.

The first four HPD BRs at the site are defined as home channel capable and must be assigned a home channel preference level through the channel record in the Unified Network Configurator (UNC). Settings for the BR are made through the UNC and CSS.

2.5 HPD GTR 8000 Site Subsystem

The GTR 8000 Site Subsystem is intended for single channel High Performance Data (HPD) sites.

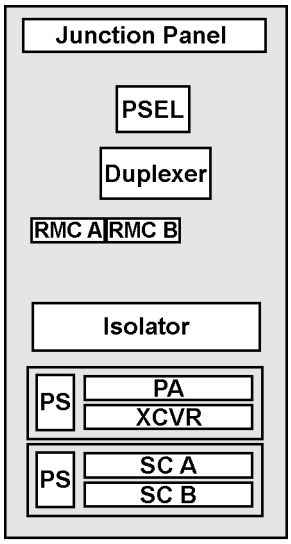
The GTR 8000 Site Subsystem includes the following components:

- HPD Site Controller (HPD SC) with redundant modules
- HPD Base Radio (HPD BR)
- Radio Frequency Distribution System (RFDS) components

The HPD SC and HPD BR in the rack are the same as the standalone versions, with similar internal connections within the rack between the HPD SC, HPD BR, and RFDS equipment.

The standard configuration for the site subsystem, as used in an HPD remote site, is shown in the following figure.

Figure 7: GTR 8000 Site Subsystem – Components



HPD_site_subsystem_config

The RFDS components provide the conditioning and distribution of inbound/outbound signaling between the BR and the antennas. The RF distribution components within the site subsystem consist of the following devices:

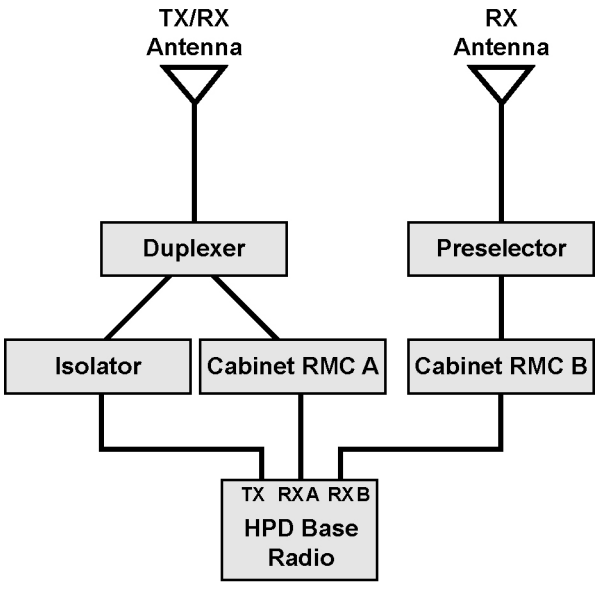
- Isolator
- Duplexer
- Receive multicouplers (A and B)
- Preselector

The transmit path includes the isolator, duplexer, and a transmit/receive antenna connector. The isolator/circulator provides high isolation against reflected power, protecting the Base Radios from reflected signaling on the transmit path. The isolator tray includes a low pass filter. The output from the isolator tray is passed through a duplexer and sent to a full-duplex transmit/receive antenna, as shown in the following figure.

For HPD operation, the receive path typically uses 2X receiver diversity for improved inbound signal reception from the MSUs. One inbound path comes through the full-duplex transmit/receive antenna (receive path A), and the other inbound path comes through the receive antenna (receive path B). On path A, the inbound signaling is received over the duplex antenna and passes through the duplexer which provides band pass filtering on the signal. The inbound signal is sent to the receive multicoupler A module, which provides low noise amplification and a 4-way splitter. The resulting signal is received into the RX A port of the BR.

The second inbound path (path B) originates at the receive antenna and passes into a preselector which filters undesired energy from the receive signal. The output of the preselector is routed to the second receive multicoupler in the rack (RMC B). The RMC amplifies, levels, and divides the signal before distribution to the RX B port of the BR. A customer-supplied tower top amplifier may be installed at the receive antenna.

Figure 8: GTR 8000 Site Subsystem – Transmit/Receive Paths



HPD_site_subsystem_txrx_path

The GTR 8000 Site Subsystem has a junction panel near the top of the rack, which is used for connection to other devices at the site. The panel includes connections to the site routers, external alarm equipment, GNSS antennas, receive and duplex antennas, and optional MOSCAD NFM site device manager.

2.6
HPD GTR 8000 Expandable Site Subsystem

The GTR 8000 Expandable Site Subsystem is an integrated rack with the Site Controller (SC), Base Radio (BR), and Radio Frequency Distribution System (RFDS) equipment.

For High Performance Data (HPD) operation, the rack includes the following components:

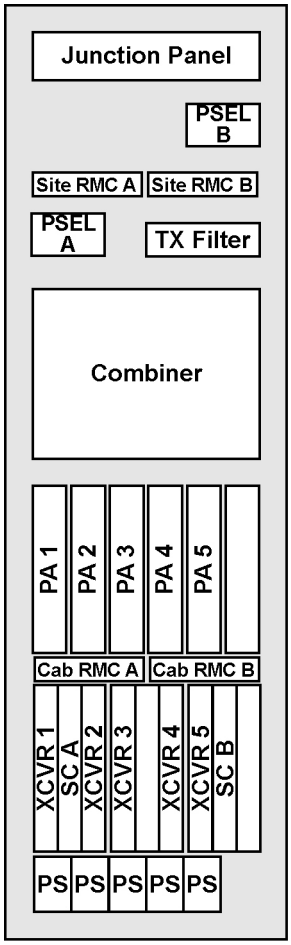
- Redundant SC modules
- Up to five transceiver modules
- Up to five power amplifier modules
- Up to five power supply modules
- RFDS equipment for the transmit and receive paths

The SC modules, transceiver modules, and power amplifier modules are arranged in the slots of the subsystem for a single cabinet configuration and an HPD Overlay cabinet configuration. Each transceiver/power amplifier pair represents a single channel in the subsystem. The HPD remote site supports up to five channels. Therefore, a maximum of five transceiver/power amplifier pairs may be installed in the subsystem rack.

The active SC module communicates with the channels and sends status messages over the backplane of the GTR 8000 Expandable Site Subsystem. The standby SC module passively monitors status messages on the backplane to determine whether the active SC is still operational.

Various messaging and signaling across the backplane include inbound/outbound traffic flow, frequency reference and synchronization signaling, Network Management traffic, and status/failover related messaging. A bank of power supplies along the bottom of the rack supply power to the modules. The rack is supplied with up to 6 AC power connections. DC power or backup batteries can also be connected. The rack can run on a combination of AC power and backup battery power, while continuing to charge the backup batteries. Installation and replacement for all the modules in the rack is accessible through the front of the rack.

Figure 9: HPD GTR 8000 Expandable Site Subsystem – Single Cabinet and Overlay Cabinet Configuration



GTR8000 Expandable Site Subsystem

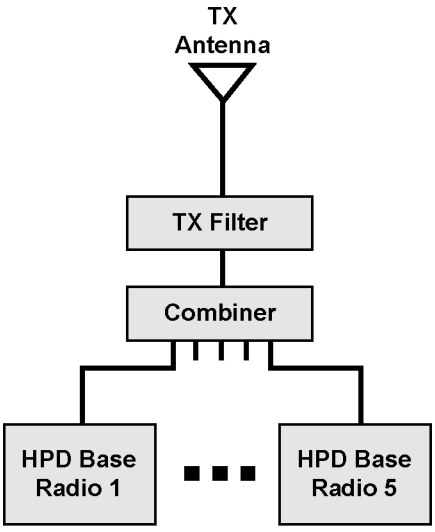
HPD_expandable_subsystem_config

The RFDS includes the following equipment for the transmit and receive paths:

- Combiner (700 MHz or 800 MHz)
- Transmit filter
- Preselectors (A and B)
- Site receives multicouplers (A and B)
- Cabinet receives multicouplers (A and B)

The transmit path consists of a combiner and transmit filter. The combiner aggregates all the transmit signals to a common line for the transmit antenna. It includes integrated isolators to protect the Base Radios from reflected signaling and to improve intermodulation performance. The transmit filter removes any remaining noise in the receiving sub-band. It includes a power monitor to measure forward and reverse power on the transmit line. If 700 MHz and 800 MHz channels are located at the site, then a custom configuration would require separate 700 MHz and 800 MHz combiners for the channels, and a diplexer would be used in place of the transmit filter.

Figure 10: GTR 8000 Expandable Site Subsystem – Transmit Path

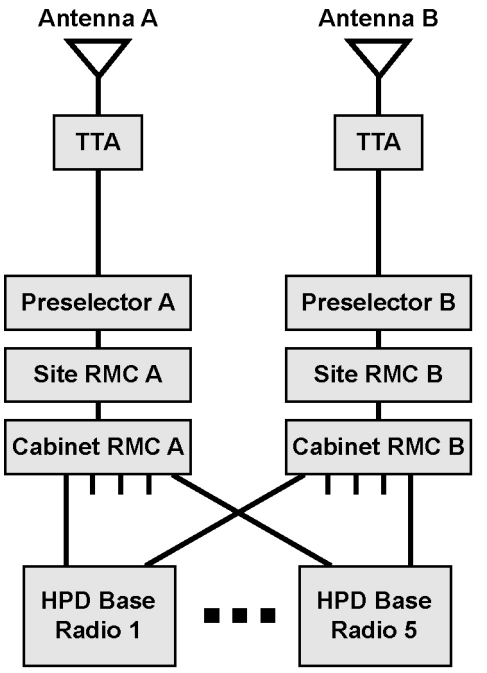


HPD_expandable_site_subsystem_tx_path

For HPD operation, 2X receiver diversity is typically used to provide improved reception of inbound traffic from MSUs, using two separate receive branches to each of the HPD BRs. The receive branches are designated as RX 'A' and RX 'B' within the subsystem equipment. Each receive branch path consists of a preselector, site RMC, and cabinet RMC. A customer-supplied Tower Top Amplifier (TTA) may be installed at the receive antenna tower. The preselector provides signal filtering for the inbound signal. The site RMC includes a low noise amplifier with a 4-way splitter that can be used to distribute inbound signaling to multiple expansion racks. The cabinet RMC is installed in the rack to provide a low noise amplifier with a 6-way splitter that is used to distribute inbound signaling to the individual HPD BRs. The cabinet RMC distributes inbound signaling to the transceiver modules over the backplane in the rack. The following figure illustrates the inbound path with receiver diversity for the GTR 8000 Expandable Site Subsystem. A total of two receive branches must be connected to each HPD BR.

System connections are made through the junction panel on the top of the rack. This panel includes the inputs and outputs for RF antennas, routers, MOSCAD NFM, alarm devices, and GNSS antennas.

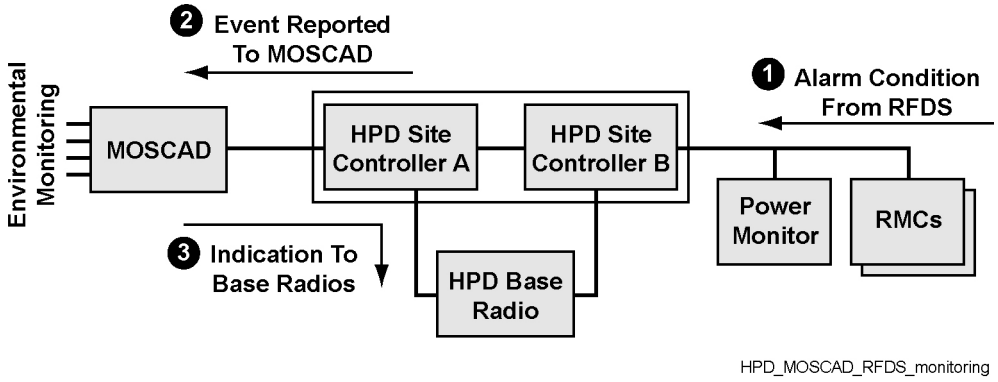
Figure 11: GTR 8000 Expandable Site Subsystem – Receive Path



2.7 MOSCAD NFM

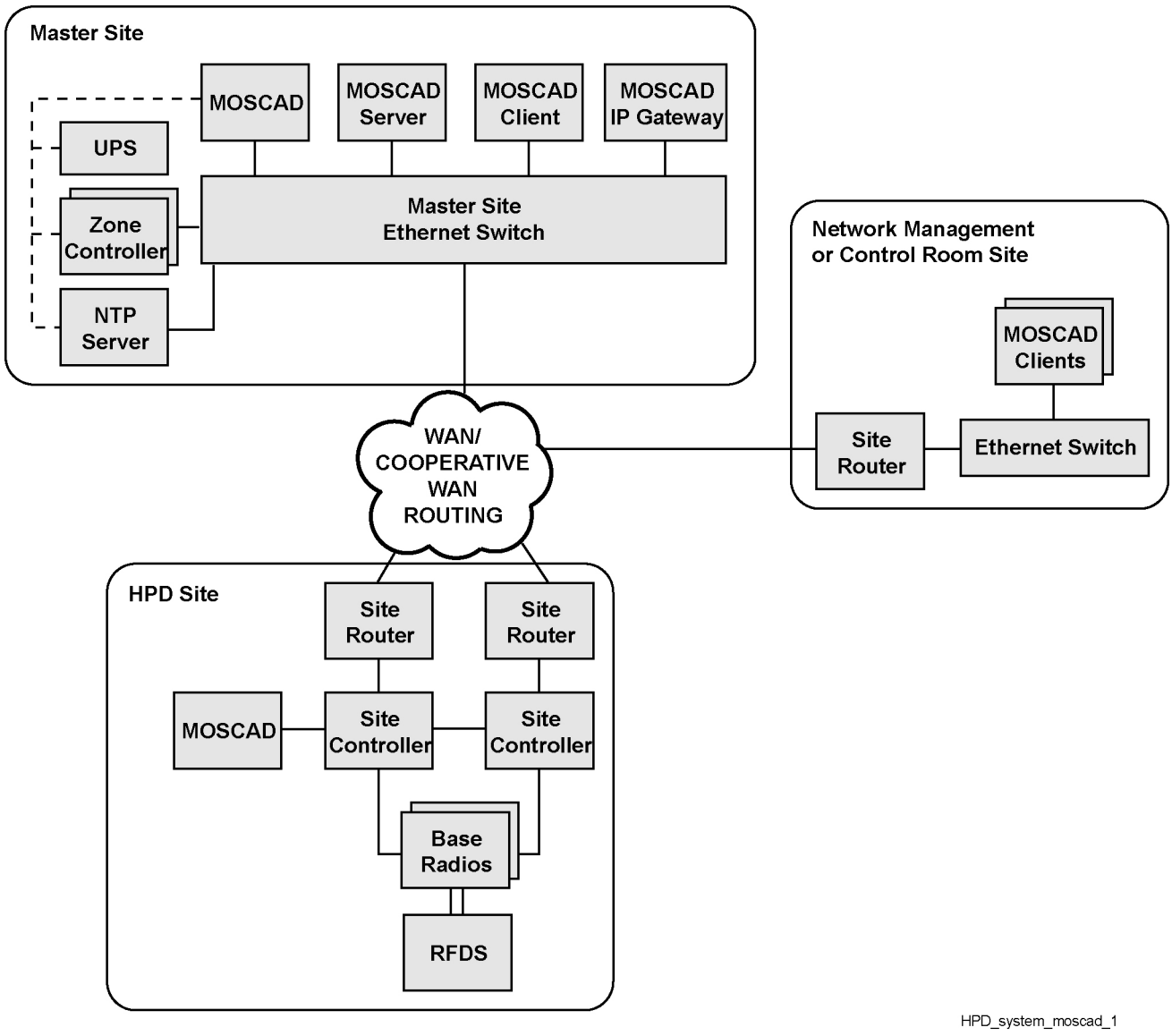
An optional MOSCAD NFM platform may be installed at the site to monitor and respond to failures on the transmit or receive paths at the High Performance Data (HPD) site. The HPD Site Controller (HPD SC) monitors the Radio Frequency Distribution System (RFDS) equipment, including the power monitor and RMCs, to determine the condition of the transmit and receive paths. Upon failure on either path, the HPD SC indicates the event to the MOSCAD NFM device. The MOSCAD NFM device responds to the HPD BRs, indicating that a failure has occurred in the RFDS. The HPD BR dekeys and sends a status message to the HPD SC indicating that the BR is no longer available.

Figure 12: MOSCAD – RFDS Monitoring



In addition, the MOSCAD NFM device may also be used to monitor environmental alarms at the site, such as diagnostic alarms, microwave equipment alarms, tower top amplifier failures, site access, or security events. Alarms detected by MOSCAD NFM are reported to the MOSCAD NFM server at the master site. Status and alarms can be viewed through the MOSCAD Fault Management application on a MOSCAD client PC.

Figure 13: MOSCAD NFM Monitoring Solutions



2.8 Software Download

The Software Download Manager application can be used to transfer and install software to remote site devices through a direct connection or central remote location.

Software Download Manager allows you to do the following tasks:

- Download software to High Performance Data (HPD) site devices
- Download software to a single instance of a device (such as one HPD Base Radio) that has been disconnected from the radio network
- Update the software on newly added channels or subsites
- Determine software and hardware versions on target devices
- Purge (delete) a software version from selected target devices
- Obtain device IP information

- Audit a session using historical information recorded by Software Download Manager

The HPD Site Controller modules and HPD Base Radios each have two banks for loading and running software. The device runs the software in one bank, while software can be simultaneously downloaded to the other inactive bank. This action can be done without interruption of services at the site. An installation causes the device to reset and activates the bank to run with the new software. Software can be loaded in different scenarios:

- Individual offline device
- Specific type of device (such as an upgrade for all HPD Base Radios)
- Site/subsystem

The HPD Site Controllers are proxy devices for software downloading. All software downloads to HPD Base Radios are first loaded to the HPD Site Controllers, and the Site Controller then transfers the software into each of the Base Radios at the site. Software Download Manager selections allow software to be transferred and/or installed into the site devices.

2.9 Configuration Service Software

The Configuration/Service Software (CSS) application is used to configure the High Performance Data (HPD) Site Controllers and HPD Base Radios. CSS also can be used to run transmit/receive tests, view status information, equalize batteries, and check internal logs of the equipment at the site. CSS can access devices remotely over the network, or locally through an Ethernet connection to the service port on the Site Controller or Base Radio.

CSS may be used with the service monitor to perform a number of tests and measurements, including measuring transmit power, frequency accuracy, transmit/receive bit error rates, and receiver sensitivity.

2.10 Site Modes

The High Performance Data (HPD) remote site can operate in three modes: the wide area, local, or site off mode. Site modes are managed and negotiated between the Zone Controller and HPD Site Controller, when possible. The site mode can change during system failure events or when a user request is made to change the site mode through the Unified Network Configurator (UNC).

Wide area mode

When in wide area mode, the HPD remote site has an active link to the master site and is able to communicate with the master site equipment. Mobile Subscriber Units (MSUs) can register and roam to wide area HPD sites and access HPD services to your organization`s networks. The Zone Controller determines when a site can be in wide area mode, based on whether an active control path is available and if a Base Radio (BR) with home channel capability is available. In the UNC, the wide area mode for the HPD remote site is also referred to as wide trunking mode.

Local mode

When an HPD remote site is in local mode, it does not support inbound and outbound HPD services and does not permit MSUs to register with the system. Broadcasts and home channel assignments still continue. MSUs always prefer to operate on a wide area site, so any existing MSUs search for an HPD site in wide area mode. Any inbound and outbound traffic that is not successfully delivered through the network is discarded and an ICMP message is delivered to the originator of the traffic. In the UNC, the local mode for the HPD remote site is also referred to as site trunking mode. HPD local mode performs differently than Integrate Voice and Data (IV&D) site trunking mode.

Site off mode

When an HPD remote site is in the site off mode, the site is shut down. No services are available.

2.10.1

HPD Base Radio Operational States

The HPD Base Radio (HPD BR) can be in one of four operational states: standby, idle, assigned, or isolated.

Standby

During initialization, the HPD BR powers up into the standby state and waits for a status packet from the HPD Site Controller (HPD SC).

Idle

After initial contact with the HPD SC has been made, the HPD BR enters idle mode and sends a status message back to the HPD SC indicating that it is ready for assignment.

Assigned

The HPD SC responds with a channel grant message, and the HPD BR is enabled for HPD service. If the BR has a greater home channel preference setting than other BRs at the site, the Zone Controller is assigned the BR as the home channel at the site. After a BR has been assigned, it begins to handle inbound/outbound HPD traffic.

Isolated

If the HPD BR fails to receive a number of consecutive status packets from the HPD SC, the BR enters isolated mode and dekey. If the BR becomes operational again and receives status packets from the SC, it replies again with a channel status message. The SC may then respond with a channel grant, and the BR becomes enabled for HPD service again.

2.10.2

HPD Site Controller Operational States

The HPD Site Controller (HPD SC) may be in one of six operational states: standby, local area, site to wide transitioning, wide area, site off, or critical malfunction.

Standby

During initialization, the HPD SC powers up into standby mode. During initialization, the SC powers up into standby mode. The newly initialized SC listens for status messages from the other SC. If the other SC is active and sending status messages, then the new SC enters standby mode.

Local area

If no status messages are received, the new SC becomes the active SC and enters local area mode.

Site to wide transitioning

The SC discovers devices on the LAN and begins sending status messages. The SC initiates communications with the Zone Controller and indicates its status to the Unified Event Manager (UEM). The Zone Controller verifies that the site link is available and that at least one Base Radio with home channel capability is available at the site. If so, the Zone Controller responds with a command to transition to wide area mode.

Wide area

After the site has transitioned to wide area mode, it sends a response to the Zone Controller, indicating Wide Trunking status.

Site off

When the SC is set to the site off mode, the site is disabled. No services are available.

Critical malfunction

If an SC detects another SC with the same device ID during initialization, the SC enters the critical malfunction state. An SC may also enter critical malfunction state if the SC receives a status message from the other SC while the other SC is in any other state than standby. This situation would indicate a conflict of active SCs, since only the active SC sends status messages. If the SC is in the critical malfunction state, reprogram and reset the SC to clear the condition.

2.11
Home Channel

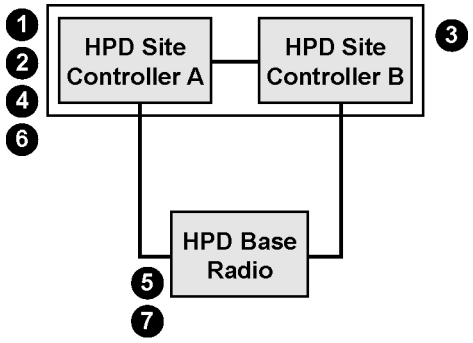
One channel at the High Performance Data (HPD) remote site operates as the active home channel. Other adjacent sites broadcast this channel, allowing Mobile Subscriber Units (MSUs) at other sites to periodically monitor the received signal strength from this site and make a location registration, if appropriate. MSUs registering at the site attempt to use the home channel. Afterwards, the HPD Site Controller may assign the MSU to another channel depending on the channel loading distribution at the site.

A total of four HPD Base Radios (HPD BRs) at the site can be configured with home channel capability, but only one HPD BR can operate as the home channel at any particular time. The BRs with home channel capability are assigned a preference level, and the BR that is enabled and configured with the first preference level is assigned as the active home channel. If the active home channel fails, the Site Controller is assigned the BR with the next preference level.

2.12
HPD Remote Site Initialization

The High Performance Data (HPD) remote site initialization involves the HPD Site Controllers (HPD SCs) and Base Radios (HPD BRs), and occurs according to the following sequence.

Figure 14: HPD Remote Site Initialization



HPD_remote_site_initialization

1 After the HPD SC is powered up, it enters standby mode and checks for status messages from the other HPD SC.

2 If status messages are not received before a timeout period, the HPD SC becomes active, monitors the LAN for HPD BRs, and begins sending status messages. If there is any contention between two HPD SCs trying to become active, then the HPD SC with the higher ID becomes the active SC at the site.

3 When the other HPD SC is powered up, it enters standby mode and receives status messages from the active SC. This SC remains in standby mode.

4 When the active SC detects an HPD BR on the LAN, it sends a report status message to the BR. This activity takes place with all BRs simultaneously.

5 The BR responds with a channel status reply to the active SC. The BR then begins to monitor periodic status messages from the active SC for keep-alive purposes.

6 The active SC receives the channel status response from the BR and begins to send background messages to the BR, then sends a channel grant to the BR.

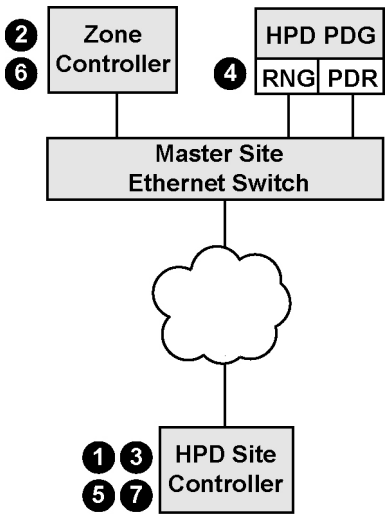
7 The BR enters the assigned operational state and keys up. It is now available for HPD operation. The BR may be assigned as the home channel by the Zone Controller if it has the greatest preference setting in the Unified Network Configurator (UNC).

2.12.1

Master Site Interaction During HPD Remote Site Initialization

In addition to the interactions at the site, there are also a number of transactions that take place between the High Performance Data (HPD) Site Controller and the master site equipment during site initialization as shown in the following figure. This process describes these interactions between the HPD Site Controller (HPD SC), Zone Controller (ZC), and HPD Radio Network Gateway (RNG) during site initialization.

Figure 15: Site Initialization – Master Site Interaction



HPD_remote_site_initialization_master_site

1. Information between the active HPD SC and the ZC is exchanged during initialization.
2. The ZC determines whether the site can transition into wide area mode. When ready, the ZC notifies the HPD SC that it can begin the transition to wide area mode.
3. The HPD SC responds to the Zone Controller and initiates a connection with the HPD RNG.
4. The HPD RNG establishes the link with the HPD SC.
5. The HPD SC notifies the ZC that the site is wide capable.
6. The ZC sends a wide grant message to the HPD SC and updates the adjacent sites.
7. The HPD SC updates its system broadcast status (Network Available) and its status message (Wide Area).

2.13

Active and Standby Site Controllers

The High Performance Data (HPD) Site Controller modules operate in an active/standby configuration for redundancy and high availability at the site. The active HPD Site Controller (HPD SC) manages operations at the site while the standby SC monitors the periodic status messages from the active SC. Depending on the site configuration and the type of loss, the standby SC becomes active when the previously active SC receives no status messages.

If there is a collision of two active SCs, the SC that receives a status message first malfunctions and stop sending status messages. The other SC remains as the active SC.

During the failover process, the newly active Site Controller must transit through the initialization process from standby state into the wide area state. During this time, HPD BRs remain keyed. However, Mobile Subscriber Units at the site have to register again with the system after the failover

process has completed, since the local database of Mobile Subscriber Units is not populated in the new active HPD SC. This new SC remains active even if the other SC recovers.

2.14 Dual Receive Diversity

High Performance Data (HPD) Base Radios support dual receive diversity for improved reception of inbound signaling from Mobile Subscriber Units at the site. The equipment uses two receive branches (A and B).

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Chapter 3

HPD Remote Site Installation

This chapter details installation procedures relating to the High Performance Data (HPD) remote site.

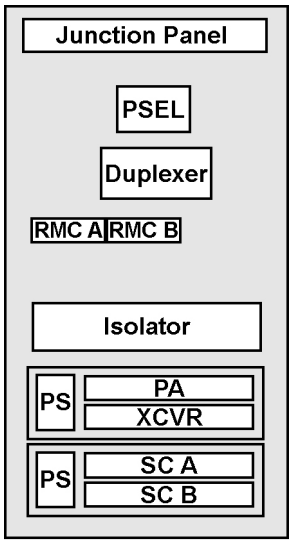
3.1 HPD Site Configurations

The High Performance Data (HPD) remote site may consist of the following components:

- One or two S2500 site routers or one or two GGM 8000 site gateways with one or two site links)
- Standalone HPD Site Controller with redundant modules
- Up to five standalone HPD Base Radios
- GTR 8000 Site Subsystem
- GTR 8000 Expandable Site Subsystem
- MOSCAD NFM monitoring device

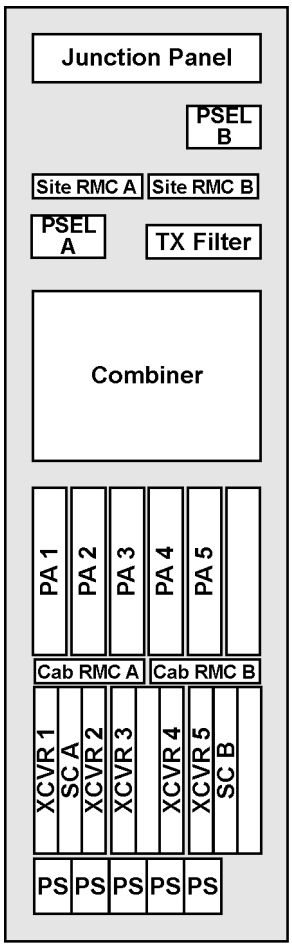
The remote site equipment configurations are illustrated in the following figures.

Figure 16: GTR 8000 Site Subsystem Configuration



HPD_site_subsystem_config

Figure 17: HPD GTR 8000 Expandable Site Subsystem – Single Cabinet and Overlay Cabinet Configuration



GTR8000 Expandable Site Subsystem

HPD_expandable_subsystem_config

3.2

Installing an HPD Remote Site

This process provides general guidelines for installing racks, cabinets, and devices at a High Performance Data (HPD) remote site.

Prerequisites:
Review the *Standards and Guidelines for Communication Sites* for the following information related to designing and installing equipment at an RF site:

- Safety guidelines
- Site selection, design, and development
- Site building design and installation
- External/internal grounding

- Power sources
- Transient voltage surge suppression
- Minimizing site interference
- Equipment installation
- Antenna installation

Process:

1. Prepare each site to comply with the Motorola Solutions requirements and specifications for the equipment, as listed in the *Standards and Guidelines for Communication Sites* manual. Other codes and guidelines that may apply to the location must also be met.
2. Inspect and inventory all racks, cabinets, cables, and other equipment with a Motorola Solutions representative to ensure that the order is complete.
3. Install all equipment using the site drawings and other documents provided by the Field Engineer. Use the installation standards and guidelines for placing and installing equipment.
4. Install all groundings for the racks and cabinets to protect against ground faults, electrical surges, and lightning in accordance with R56 standards.
5. Connect all cables within each rack and between multiple racks, where required.
6. Run a preliminary check of all sites before applying power and starting the initial software installations.

3.2.1
Required Tools for Hardware Installation

You need various tools to install, optimize, and service the equipment. If information is needed regarding where to obtain any of the equipment and tools listed, contact the Motorola Solution Support Center (SSC). The following is a list of general recommended tools for installing and servicing equipment at an High Performance Data (HPD) remote site:

- 150 MHz 4-channel digital storage oscilloscope
- Transmission test set (TIMS Set)
- 50 ohm terminated load
- Digital multimeter (DMM)
- Antenna tester
- Service Monitor: Aeroflex 3900 Series Service Monitor with P25 Options installed (plus HPD and TDMA options as required)
- Personal Computer meeting the following specifications:
  - Operating Systems:
    + Windows XP Home Edition
    + Windows XP Professional
    + Windows Vista (all editions)
    + Windows 7
  - Hardware Requirements:
    + Processor:
      - 1 GHz or higher Pentium grade
    + Processor Memory:

    - 1 GB RAM recommended for Windows XP
    - 2 GB recommended for Windows Vista and Windows 7
  + Hard Disk Space:
    - 300 MB minimum free space (for a Typical Installation, including Help Text and Software Download Manager) or 100 MB minimum free space (for a Compact Installation)
  + Peripherals:
    - Microsoft Windows supported Mouse or Trackball
    - Microsoft Windows supported Serial Port for product communication
    - Microsoft Windows supported Ethernet Port for product communication
    - Microsoft Windows supported Printer Port for report printing
    - CD-ROM for software installation
- Terminal emulation software
- DB-9 straight through serial cable
- RS232 cables with connectors
- Punch block impact tool
- MODAPT RJ45 breakout box
- Remote RJ11/RJ45 cable tester (1200 feet length maximum)
- PC cable tester with RG58, 59, 62, BNC, RJ45, RJ11, DB9, DB15, DB25, Centronics 36 pin connectors
- Electrostatic Discharge (ESD) field service kit
- Amprobe Instruments GP-1 earth tester
- AEMC 3730 clamp-on ground resistance tester

The following is a list of recommended networking tools for installing and servicing the network:

- Fluke® OneTouch Assistant LAN tester
- Ni-MH rechargeable battery for Fluke
- T1/E1 or E1 test set (such as the Hewlett-Packard® HP37702A)
- Serialtest® software with ComProbe® and SerialBERT option
- Ethernet Service Kit
- Configuration/Service Software (CSS) DLN6455
- Standard RS-232 straight through (DB-9 male to DB-9 female) cable
- Rohde&Schwarz NRT-Z14 Directional Power Sensor 25-1000 GHz 0.1-120W. Recommended for all uses when a service monitor is not available.

3.3 Power Requirements

All equipment at the site supports operation from 120/240 VAC nominal single phase power sources at 50/60 Hz. The High Performance Data (HPD) Site Controller (HPD SC), HPD Base Radios (HPD BRs), and racked subsystems also support operation from a 48 VDC power source or battery. The GTR 8000 Expandable Site Subsystem can be supplied with up to six 120/240 VAC inputs and up to two separate branches of DC/battery input to the power supplies in the rack.

The HPD SC and BR have automatic battery revert capabilities and can charge batteries from the AC power supply. The power supply includes an integrated charging system that eliminates the need for

UPS and that provides battery equalization. For the GTR 8000 Base Radio platform, the integrated distributed site rectifier provides 3 A charging per power supply module. The SC or BR monitors the battery charge and temperature conditions and may be viewed through Configuration/Service Software (CSS).

The HPD SC and BR are able to provide 28.6 V auxiliary power outputs to another connected device (HPD SC or RMC) as a backup power source to allow the connected device with a power supply failure to maintain continued operation. The GTR 8000 Expandable Site Subsystem has an internal auxiliary power configuration for the SC modules and Radio Frequency Distribution System (RFDS) equipment.

Follow the guidelines in *Standards and Guidelines for Communication Sites* for information on providing electrical service, power budgeting, selecting batteries, and other topics for supplying power at the site.

3.4 Site Router or Site Gateways

The High Performance Data (HPD) site may include one or two site routers (S2500s) or site gateways (GGM 8000s).

The S2500 site router requires the following optional hardware:

ST2512 – T1/E1 module
Required if the HPD remote site is connected to the master site router on a T1/E1 link.

ST2010 – Ethernet module
Required if the HPD remote site is connected to the master site router on an Ethernet link.

The GGM 8000 site gateway base unit provides sufficient T1/E1 and Ethernet interfaces for connection to the master site router on either a T1/E1 or Ethernet link. In addition, the GGM 8000 base unit supports up to 16 IP conventional (digital over IP interface) channels (no additional hardware is required).

NOTICE: The number of IP conventional channels supported by the GGM 8000 base unit depends on how the **Conventional Gateway Type** field is set in the Provisioning Manager. If the **Conventional Gateway Type** is set to **Combination-HD** (the default value), the GGM 8000 supports up to 16 IP conventional channels. If the **Conventional Gateway Type** is set to **Combination**, the GGM 8000 supports up to 10 IP conventional channels.

If the HPD remote site supports channel types other than IP conventional (analog conventional, digital conventional (digital over V.24 interface), mixed mode, MDC 1200, or ACIM), the following optional hardware is required:

- S2500 site router
  ST2513 – 4-wire E&M module
  Supports up to 4 analog conventional channels.

  ST2514 – V.24 module(s)
  Supports 1 digital conventional channel per module, up to 2 channels per chassis.

  NOTICE: The S2500 site router supports either analog conventional or digital conventional channels. It does not support analog conventional and digital conventional channels simultaneously, and it does not support IP conventional, mixed mode, MDC 1200, or ACIM channels.

  ST2511 – FlexWAN module
  Supports the V.35 connection to a channel bank for circuit-based mutual aid channels; 1 channel per chassis.
- GGM 8000 site gateway
  TYN4002A – Analog/V.24 interface kit
  Supports any combination of up to 4 analog conventional, digital conventional, mixed mode, MDC 1200, or ACIM channels.

TYN4012A – Low Density Enhanced Conventional Gateway module
Supports up to 4 channels using an analog interface (analog conventional, MDC 1200, mixed mode, ACIM) simultaneously with up to 4 channels using a V.24 interface (digital conventional, mixed mode, ACIM).

TYN4011A – High Density Enhanced Conventional Gateway module
Supports up to 8 channels using an analog interface (analog conventional, MDC 1200, mixed mode, ACIM) simultaneously with up to 8 channels using a V.24 interface (digital conventional, mixed mode, ACIM).

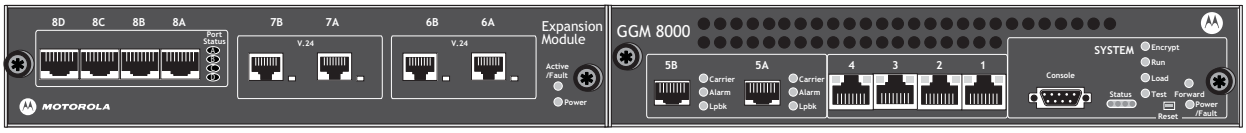
TYN4007A – FlexWAN module(s)
Supports the V.35 connection to a channel back for circuit-based mutual aid channels; 1 channel per module, up to 2 channels per chassis.

For more information, see the *S6000 and S2500 System Routers* and the *GGM 8000 System Gateways* manuals.

Figure 18: HPD Site Router (MNR S2500) with E&M module

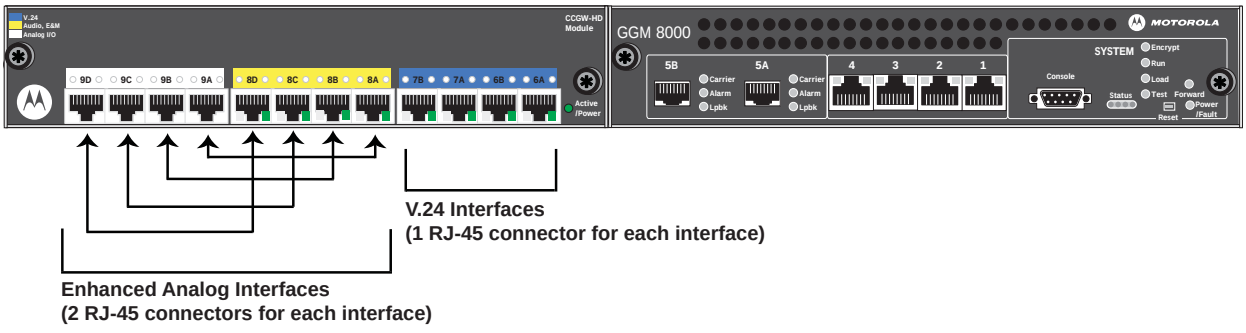
S2500_router_front

Figure 19: HPD Site Gateway (GGM 8000) with Analog/V.24 Interface Kit



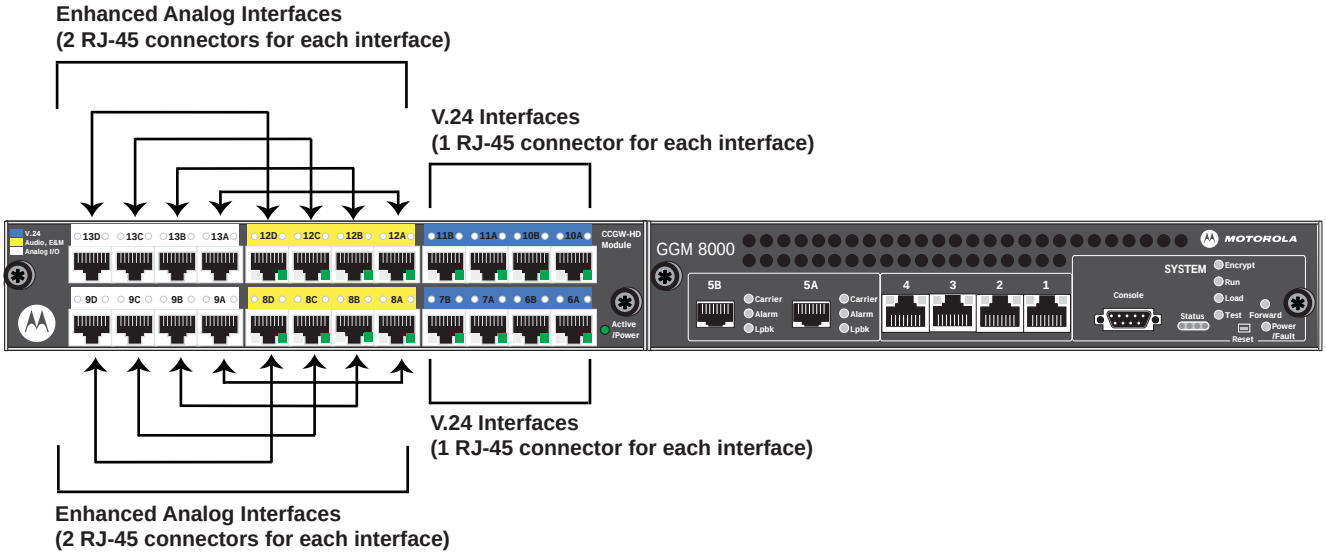
expansion_E_M_V24_no_callouts_A

Figure 20: HPD Site Gateway (GGM 8000) with Low Density Enhanced Conventional Gateway Module



SD_ECCGW_interface_pairs_A

Figure 21: HPD Site Gateway (GGM 8000) with High Density Enhanced Conventional Gateway Module



HD_ECCGW_interface_pairs_A

Table 1: Site Router and Site Gateway Connections

Device	Port / Type	Device	Port / Type	Description
Primary Site Router or Primary Site Gateway	LAN 1, RJ45	HPD Site Controller A	Router A port, RJ45	• If a standalone Site Controller is at the site, then the connection is made to the router or gateway port on the Site Controller A module on its internal switch. • If a GTR 8000 Site Subsystem or GTR 8000 Expandable Site Subsystem is being used at the site, then this connection is to the router A or gateway A port on the junction panel.
Primary Site Router	T1/E1, RJ45	Primary Site Link	T1/E1	Connection to the site link (or CSU/DSU).
Primary Site Router	4-wire E&M ports, RJ45	Conventional base station (optional)	RJ45 (or other plus adapter)	If IP-based analog conventional mutual aid stations are colocated at the site, up to four stations may be connected to an optional analog 4-wire E&M module in the router. See the conventional base station documentation for connection requirements.

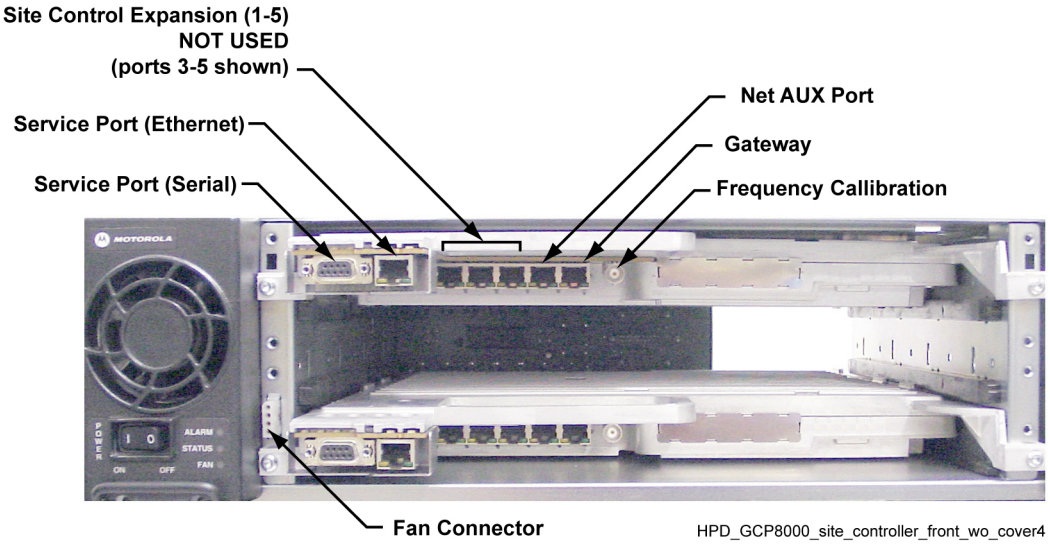
Table continued…

Device	Port / Type	Device	Port / Type	Description
Primary Site Router or Primary Site Gateway	60-pin FlexWAN	Channel bank (optional)	60-pin FlexWAN	If circuit-based mutual aid equipment is located at the site, then a v.35 FlexWAN connection can be made to a channel bank to support the circuit-based equipment.
Secondary Site Router or Secondary Site Gateway (optional)	LAN 1, RJ45	HPD Site Controller B	Router B port, RJ45	The secondary site router and its connections are only required if redundant site links are installed at the site. • If a standalone Site Controller is at the site, then the connection is made to the Router port on the Site Controller B module on its internal switch. • If a GTR 8000 Site Subsystem or GTR 8000 Expandable Site Subsystem is being used at the site, then this connection is to the Router B port on the junction panel.
Secondary Site Router or Secondary Site Gateway (optional)	T1/E1, RJ45	Backup Site Link	T1/E1	Connection to the secondary/backup site link (or CSU/DSU).
Secondary Site Router or Secondary Site Gateway (optional)	4-wire E&M ports, RJ45	Conventional base station	RJ45 (or other plus adapter)	If IP-based analog conventional mutual aid stations are colocated at the site, up to four stations may be connected (optional analog 4-wire E&M module required in the router.)

3.5 HPD GCP 8000 Site Controller

The High Performance Data (HPD) Site Controller must be connected with the site routers or site gateways, HPD Base Radios, and GNSS antennas. The Site Controller includes additional connections for auxiliary power, alarm monitoring, and optional MOSCAD NFM monitoring equipment. The following figures show the connections for the HPD Site Controller.

Figure 22: HPD GCP 8000 Site Controller (Front View) – Gateway and MOSCAD NFM (Net AUX) Connections



NOTICE: The EXT FREQ REF, and 1 PPS connections are not used for HPD operation.

Figure 23: GCP 8000 Site Controller Ports for a GTR 8000 Expandable Site Subsystem

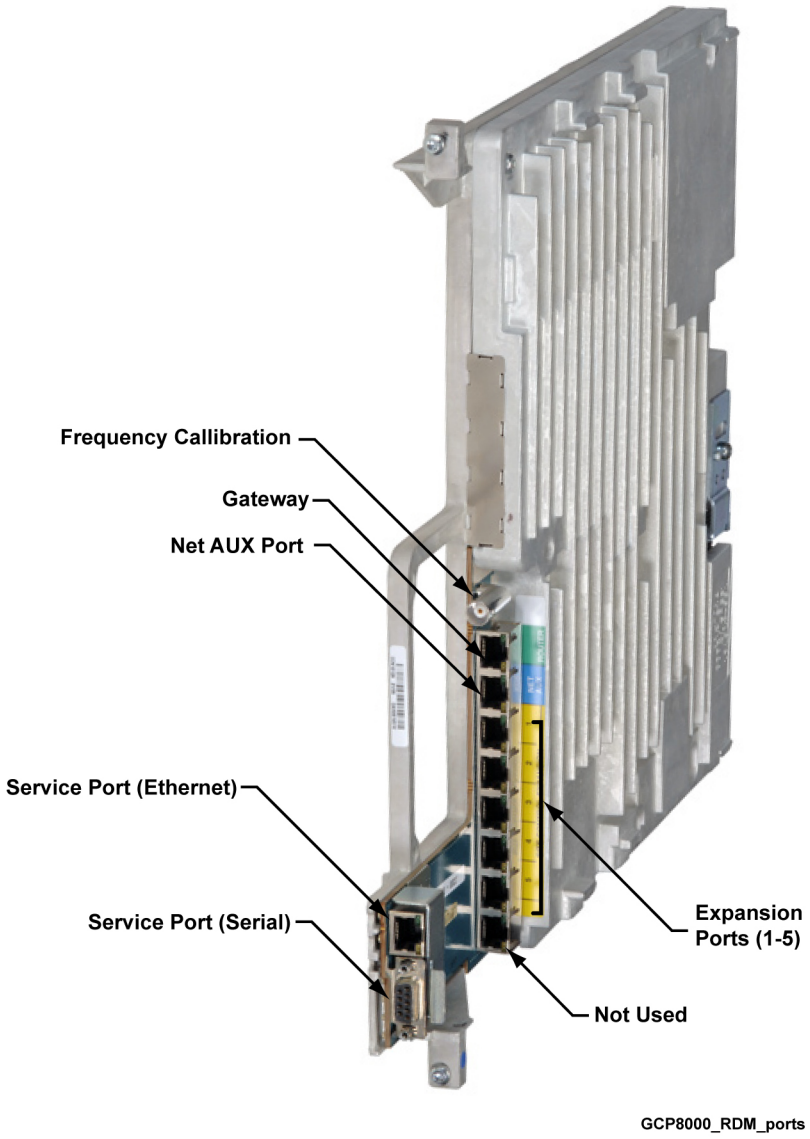


Table 2: Description of Ports on the GCP 8000 Site Controller (Front View)

Port	Description	Hardware Configuration
Service Port (DB-9)	Service port for initial configuration of the Site Controller IP address.	• Standalone • GTR 8000 Site Subsystem • GTR 8000 Expandable Site Subsystem
Service Port (RJ45)	Connects to service computer/ laptop for local access using Con- figuration/Service Software. Also	• Standalone • GTR 8000 Site Subsystem • GTR 8000 Expandable Site Subsystem

Table continued…

Port	Description	Hardware Configuration
	may be used for localized software downloads.	
Gateway port	LAN connection to the primary site router or primary site gateway.	• Standalone • GTR 8000 Site Subsystem • GTR 8000 Expandable Site Subsystem
NET AUX	LAN connection to the MOSCAD NFM site device manager for local fault monitoring.	• Standalone • GTR 8000 Site Subsystem • GTR 8000 Expandable Site Subsystem
Site Control Expansion (1-5)	Only ports 1–5 are available for connecting to Expansion Hubs.	• GTR 8000 Expandable Site Subsystem
Frequency Calibration	Port available on the Site Controller module for measuring and calibrating the frequency reference.	• Standalone • GTR 8000 Site Subsystem • GTR 8000 Expandable Site Subsystem
Fan Connector	Plug in connection when the fan assembly is mounted.	• Standalone • GTR 8000 Site Subsystem • GTR 8000 Expandable Site Subsystem

Figure 24: HPD GCP 8000 Site Controller – Rear

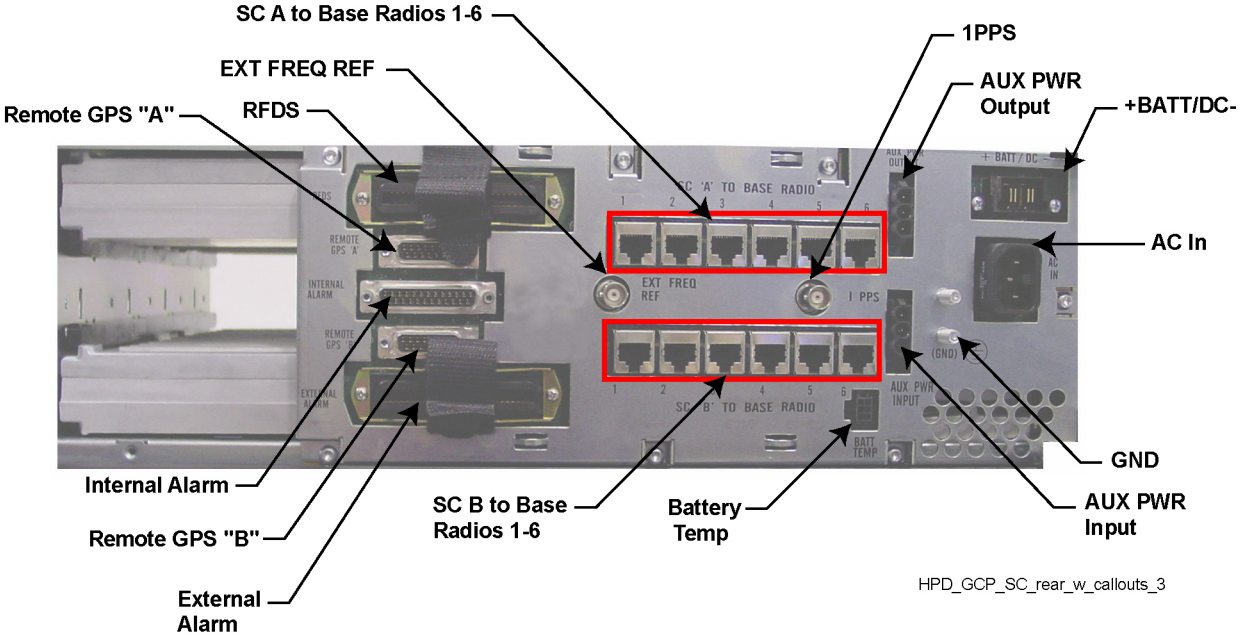


Table 3: Description of Ports on the GCP 8000 Site Controller (Rear View)

Port	Description	Hardware Configuration
RFDS	Monitors RFDS alarms from the power monitor and receiver multi-coupler.	• Standalone • GTR 8000 Site Subsystem – used only for HPD systems.
Remote GPS ‘A'	Connection between the RGPS A and the GCP 8000 Site Controller.	• Standalone • GTR 8000 Site Subsystem – used only for HPD systems.
Internal Alarm	Not in use	Not in use
Remote GPS ‘B'	Connection between the RGPS B and the GCP 8000 Site Controller.	• Standalone • GTR 8000 Site Subsystem – used only for HPD systems.
External Alarm	Not in use	Not in use
SC ‘A' to Base Radio 1-6/ RJ45	Not in use	Not in use
SC ‘A' to Base Radio 1-6/ RJ45	Connection between the Site Controller A and GTR 8000 Base Radios at the site.	• Standalone • GTR 8000 Site Subsystem – HPD only Port 1 to Base Radio Ports 1–5. – used only for HPD systems.
EXT FREQ REF	Not in use	Not in use
1 PPS	Not in use	Not in use
SC ‘B' to Base Radio 1-6/ RJ45	Connection between the Site Controller B and GTR 8000 Base Radios at the site.	• Standalone • GTR 8000 Site Subsystem – HPD only Port 1 to Base Radio Ports 1–5. – used only for HPD systems.
Battery Temp	Connection to temperature sensor, allowing for a temperature compensated battery charging.	• Standalone • GTR 8000 Site Subsystem
AUX PWR Output	Reserved for future use.	Reserved for future use.
AUX PWR Input	The auxiliary input is connected with a GTR 8000 Base Radio as a secondary power source.	• Standalone • GTR 8000 Site Subsystem – used only for HPD systems.
+ Batt/DC -	Input from a +/- 48 VDC nominal power supply. Input from, and charging output to, backup battery.	• Standalone • GTR 8000 Site Subsystem
AC	Input from 90/264 VAC nominal power source.	• Standalone • GTR 8000 Site Subsystem

Table continued…

Port	Description	Hardware Configuration
GND	Two grounding lugs and cable.	• Standalone • GTR 8000 Site Subsystem

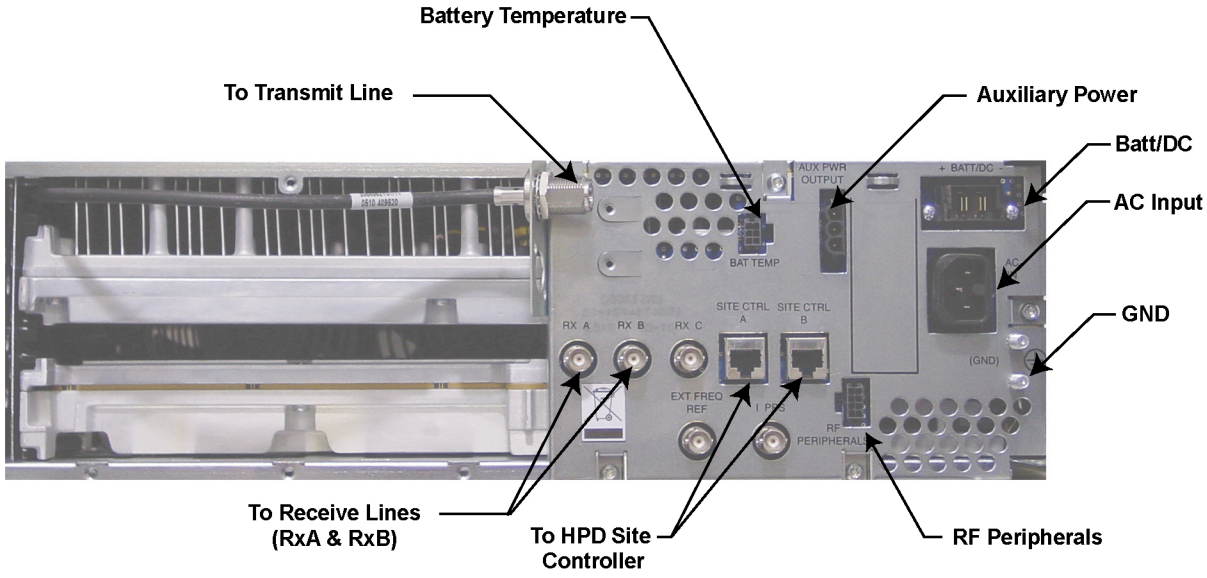
3.6

HPD GTR 8000 Base Radio

The standalone High Performance Data (HPD) Base Radio (HPD BR) connects with each of the HPD Site Controllers (HPD SCs) and to the transmit and receive paths.

NOTICE: Connections for RX C, EXT FREQ REF, and 1 PPS ports are not used for HPD operation.

Figure 25: HPD GTR 8000 Base Radio – Rear



HPD_GTR8000_base_radio_rear1

Table 4: HPD GTR 8000 Base Radio Connections

Device	Port / Type	Device	Port / Type	Description
HPD Base Radio	SC A port, RJ45	HPD Site Controller A	Base radio port, RJ45	Connects to Site Controller A Base Radio port for this channel (1-5). This port is located on the rear of the HPD BR, as shown in Figure 25: HPD GTR 8000 Base Radio – Rear on page 55. **NOTICE:** The length of the cable between the Site Controller and the Base Radio should be no greater than 30 ft.

Table continued…

Device	Port / Type	Device	Port / Type	Description
HPD Base Radio	SC B port, RJ45	HPD Site Controller B	Base radio port, RJ45	Connects to Site Controller B Base Radio port for this channel (1-5). This port is located on the rear of the HPD BR, as shown in Figure 25: HPD GTR 8000 Base Radio – Rear on page 55.
HPD Base Radio	RX A, BNC	Receive line A	BNC	RF coax to receive path for antenna A. This port is located on the rear of the HPD BR, as shown in Figure 25: HPD GTR 8000 Base Radio – Rear on page 55.
HPD Base Radio	RX B, BNC	Receive line B	BNC	RF coax to receive path for antenna B. This port is located on the rear of the HPD BR, as shown in Figure 25: HPD GTR 8000 Base Radio – Rear on page 55.
HPD Base Radio	Transmit port, N-type	Transmit line	N-type	RF coax to transmit antenna. This connection is located on the rear of the HPD BR, as shown in Figure 25: HPD GTR 8000 Base Radio – Rear on page 55.
HPD Base Radio	Service port, RJ45	Service computer/ laptop	LAN port, RJ45	Service port for local access using Configuration/Service Software. Also may be used for localized software downloads. Located on the front of the transceiver module. **NOTICE:** The RJ45 service port supports only 10 MB half duplex operation.
HPD Base Radio	Service port, DB9	Service computer/ laptop	RS232 port, DB9	A service serial port for initial configuration of the Base Radio IP address, located on the front of the transceiver module.
HPD Base Radio	Aux Pwr Output	HPD Site Controller or RMC/LNA	Aux Pwr Input	The auxiliary output power can be connected with the HPD Site Controller or RMC to provide secondary power to the device. This port is located on the rear of the HPD BR as shown in Figure 25: HPD GTR 8000 Base Radio – Rear on page 55.
HPD Base Radio	Bat Temp, 6-pin	Battery temperature sensor		Connection allowing the BR to monitor the battery temperature. Located on the rear of the HPD BR.

Table continued…

Device	Port / Type	Device	Port / Type	Description
HPD Base Radio	RF Peripherals	RF peripheral sensor ports		Antenna relay and presence detect, external circulator load temperature (external wattmeter not supported). Located on the rear of the HPD BR.
HPD Base Radio	Batt/DC	DC power supply or battery		Input from and output to a 48 VDC power supply or backup battery. Located on the rear of the HPD BR.
HPD Base Radio	AC	120/240 VAC power source.		Input from 120/240 VAC nominal power source. Located on the rear of the HPD BR.

3.7
HPD GTR 8000 Site Subsystem

The HPD GTR 8000 Site Subsystem contains a standalone Site Controller, standalone Base Radio, and a Radio Frequency Distribution System (RFDS), mounted in a single rack. The RFDS consists of an isolator, duplexer, two branch RMCs, and a preselector.

Figure 26: GTR 8000 Site Subsystem – Junction Panel

The following illustration shows the junction panel used on the subsystem.

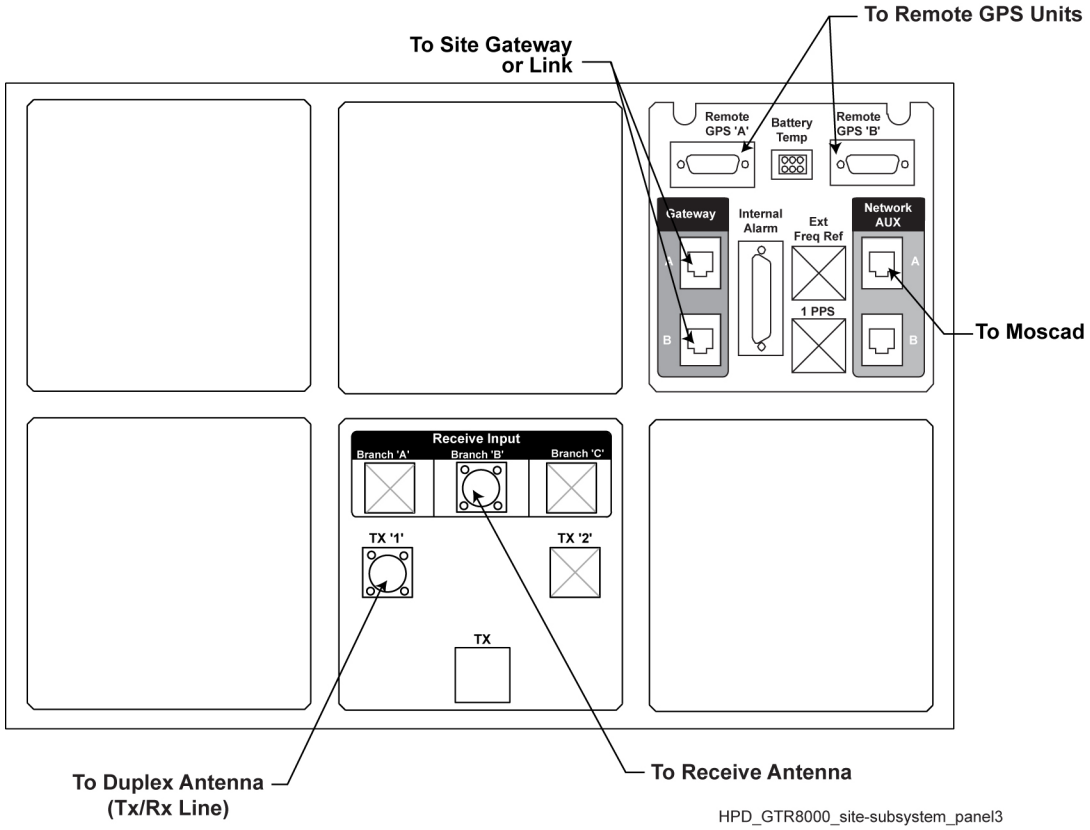


Table 5: HPD GTR 8000 Site Subsystem Connections

The following table describes the connections from the subsystem to the other equipment at a site.

Device	Port / Type	Device	Port / Type	Description
HPD GTR 8000 Site Subsystem, Junction Panel	Router A port, RJ45	Primary Site Router or Primary Site Gateway	LAN 1, RJ45	Ethernet link between Site Controller A and the primary site router or primary site gateway.
HPD GTR 8000 Site Subsystem, Junction Panel	Router B port, RJ45	Secondary Site Router or Secondary Site Gateway (optional)	LAN 1, RJ45	Ethernet link between Site Controller B and secondary site router or secondary site gateway (if installed).
HPD GTR 8000 Site Subsystem, Junction Panel	Network AUX A, RJ45	MOSCAD NFM	LAN Port 1, RJ45	Ethernet link for MOSCAD NFM device.
HPD GTR 8000 Site Subsystem, Junction Panel	Network AUX	Conventional Channel Gateway (CCGW) or site gateway (conven-	LAN 1, RJ45	This connection would only be used if there were one site link and two routers or gateways

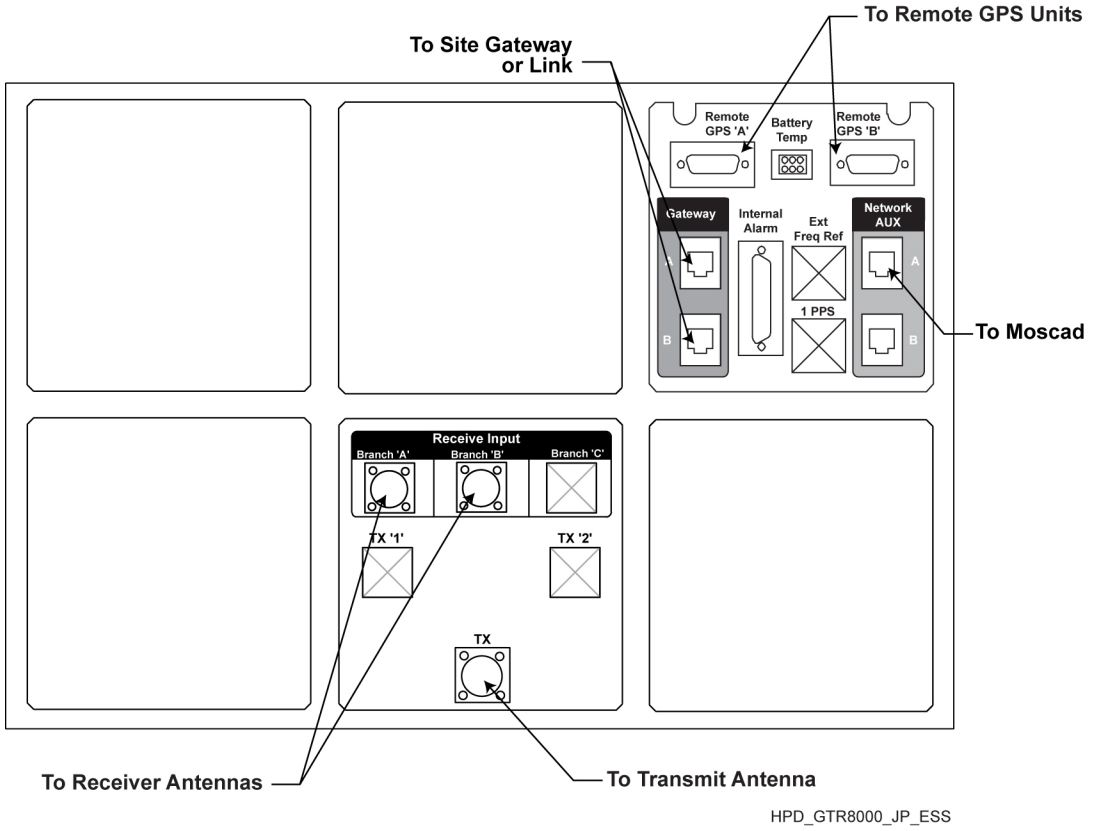
Table continued...

Device	Port / Type	Device	Port / Type	Description
	B, RJ45	tional channel interface)		supporting conventional channel operation at the site.
HPD GTR 8000 Site Subsystem, Junction Panel	Battery Temp	Backup Battery Temperature Sensor		See battery temperature sensor instructions for connection requirements.
HPD GTR 8000 Site Subsystem, Junction Panel	Remote GPS A, DB15	Lightning Arrestor / RGPS Unit A	Line terminals	See Figure 28: RGPS and Lightning Arrestor – System Connections on page 62 for terminal connection details on the lightning arrestor.
HPD GTR 8000 Site Subsystem, Junction Panel	Remote GPS B, DB15	Lightning Arrestor / RGPS Unit B	Line terminals	See Figure 28: RGPS and Lightning Arrestor – System Connections on page 62 for terminal connection details on the lightning arrestor.
HPD GTR 8000 Site Subsystem, Junction Panel	Internal Alarm, DB25	External integrated alarm card (IAC) connections.		Not supported.
HPD GTR 8000 Site Subsystem, Junction Panel	RX 'B', N-type	Receive antenna		RF coax to receive antenna.
HPD GTR 8000 Site Subsystem, Junction Panel	TX 'A', N-type	Transmit/receive (full-duplex) antenna		RF coax to transmit/receive antenna for full-duplex operation.

3.8 HPD GTR 8000 Expandable Site Subsystem

The GTR 8000 Expandable Site Subsystem includes two Site Controller modules, up to five transceivers and power amplifier modules, and Radio Frequency Distribution System (RFDS). Internal connections between modules are made through the backplane. A junction panel is located at the top of the rack for connections to other devices at the High Performance Data (HPD) remote site as shown in the following figure.

Figure 27: GTR 8000 Expandable Site Subsystem Junction Panel – Single Cabinet Configuration



The subsystem rack accepts up to six 120/240 VAC inputs and two separate 48 VDC inputs for battery or DC power source input. The DC terminals on the top left of the rack internally connect the left three power supplies. The DC terminals on the top right corner of the rack internally connect with the three power supplies in the lower right portion of the subsystem rack.

Table 6: HPD GTR 8000 Expandable Site Subsystem Connections Junction Panel – Single Cabinet Configuration

Device	Port / Type	Device	Port / Type	Description
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	Router A port, RJ45	Primary Site Router or Primary Site Gateway	LAN 1, RJ45	Ethernet link between Site Controller A and the primary site router or primary site gateway.
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	Router B port, RJ45	Secondary Site Router or Secondary Site Gateway (optional)	LAN 1, RJ45	Ethernet link between Site Controller B and secondary site router or secondary site gateway (if installed).
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	Network AUX A, RJ45	MOSCAD NFM	LAN Port 1, RJ45	Ethernet link for MOSCAD NFM device.

Table continued...

Device	Port / Type	Device	Port / Type	Description
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	Network AUX B, RJ45	Conventional Channel Gateway (CCGW) or site gateway (conventional channel interface)	LAN 1, RJ45	This connection would only be used if there were one site link and two routers or gateways supporting at the site.
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	Battery Temp, 6-pin	Backup Battery Temperature Sensor		See battery temperature sensor instructions for connection requirements.
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	Remote GPS A, DB15	Lightning Arrestor / GPS Unit A	Line terminals	See Figure 28: RGPS and Lightning Arrestor – System Connections on page 62 for terminal connection details on the lightning arrestor.
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	Remote GPS B, DB15	Lightning Arrestor / RGPS Unit B	Line terminals	See Figure 28: RGPS and Lightning Arrestor – System Connections on page 62 for terminal connection details on the lightning arrestor.
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	Internal Alarm, DB25			Not in use
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	RX A, N-type	Receive antenna A / tower top amplifier	TTA output port	RF coax to receive branch A.
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	RX B, N-type	Receive antenna B / tower top amplifier	TTA output port	RF coax to receive branch B.
HPD GTR 8000 Expandable Site Subsystem, Junction Panel	TX, 7/16	Transmit antenna	Tx input port	RF coax to transmit antenna.

3.9 Remote GNSS Unit

A Remote Global Navigation Satellite System (RGPS) unit and lightning arrestor is connected for each High Performance Data (HPD) site controller module. There are two types of lightning arrestors available. The following figures show the required connections and terminal assignments for installing the two types of lightning arrestor.

Figure 28: RGPS and Lightning Arrestor – System Connections

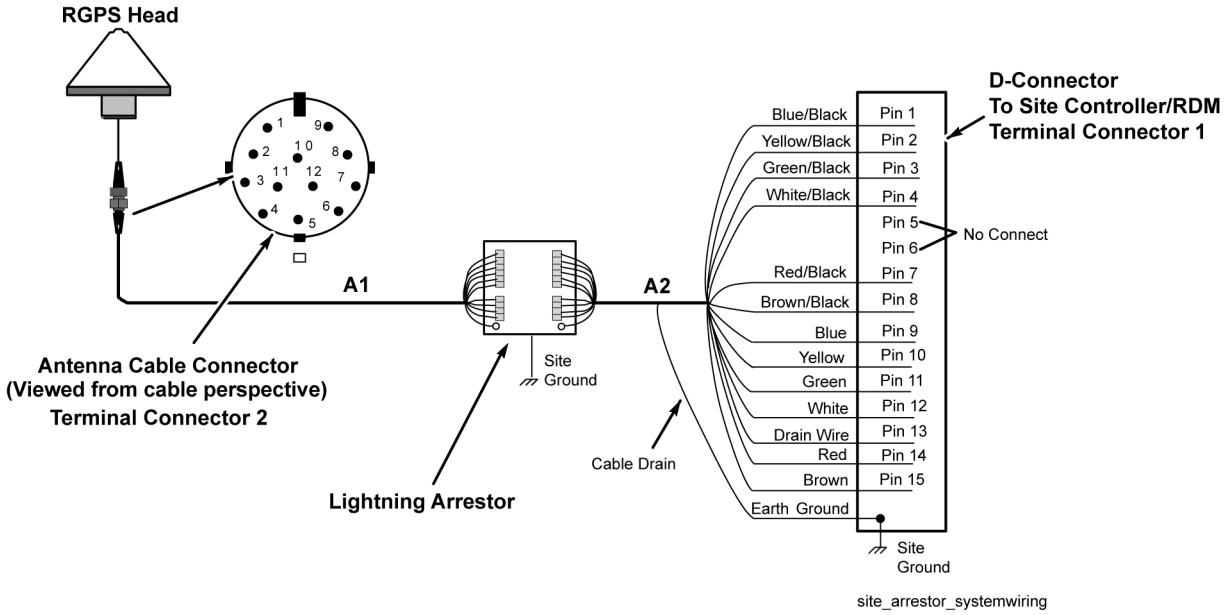
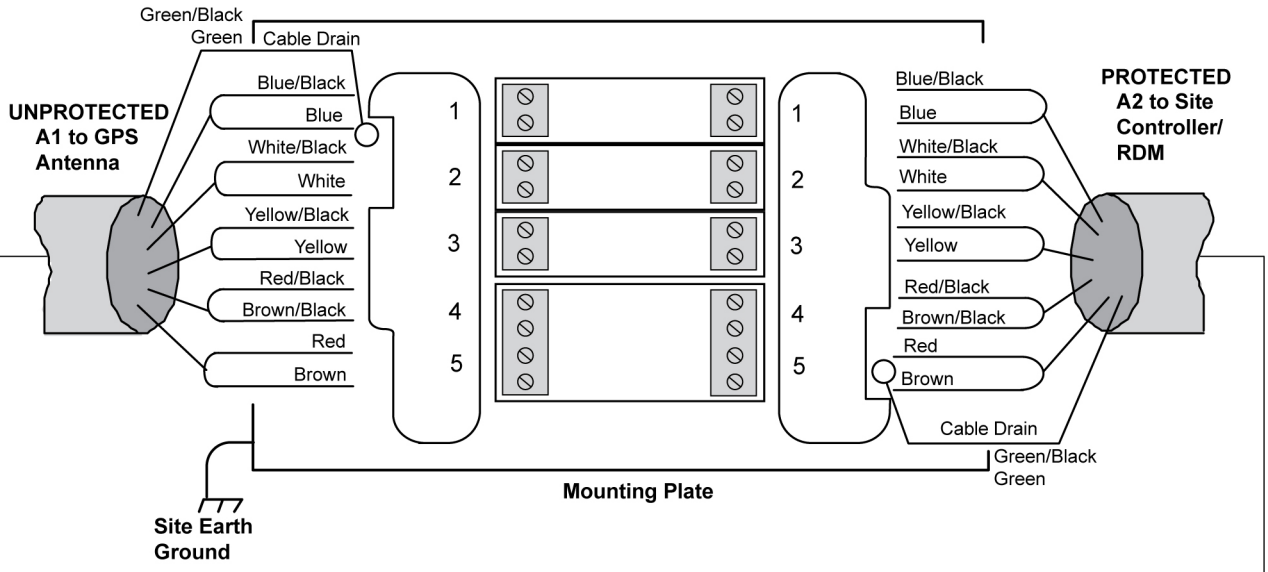


Figure 29: Lightning Arrestor DSIX-2L1M1DC48-IG – Wiring

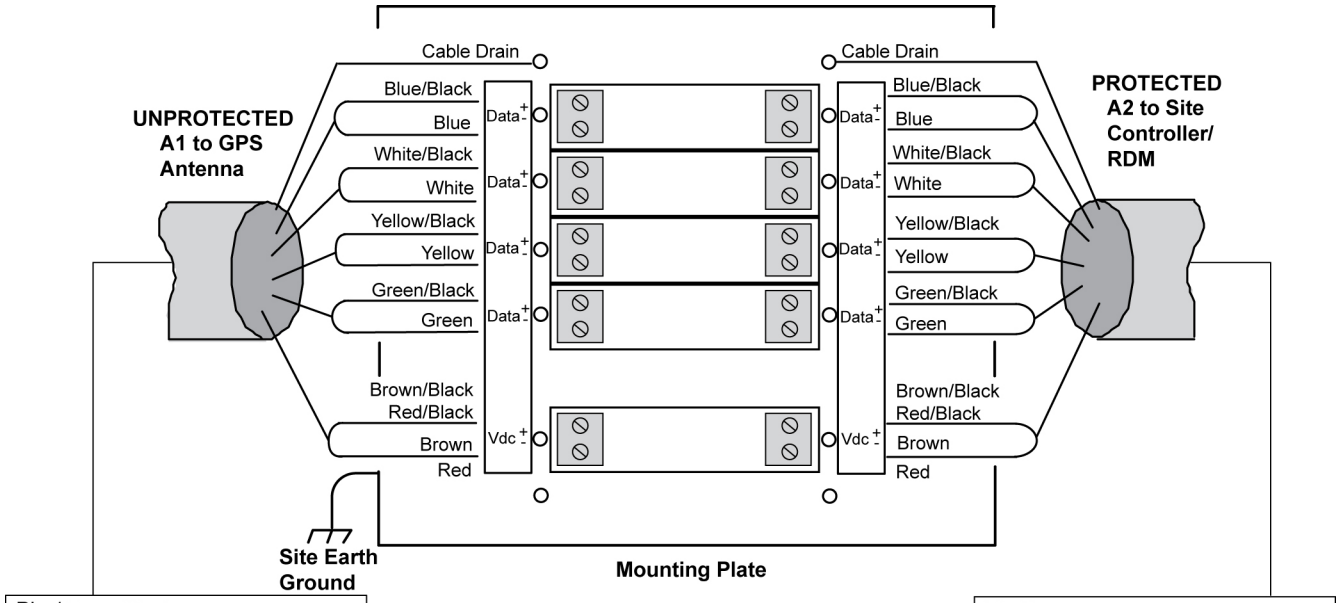


Pin 1 Brown/Black	= Power
Pin 2 White	= Transmit Data -
Pin 3 White/Black	= Transmit Data +
Pin 4 Blue	= Receive Data -
Pin 5 Blue/Black	= Receive Data +
Pin 6 Green	= Not Used
Pin 7 Green/Black	= Not Used
Pin 8 Red	= Power Return
Pin 9 Brown	= Power Return
Pin 10 Red/Black	= Power
Pin 11 Yellow/Black	= 1PPS +
Pin 12 Yellow	= 1PPS -

Pin 8 Brown/Black	= Power
Pin 12 White	= Transmit Data -
Pin 4 White/Black	= Transmit Data +
Pin 9 Blue	= Receive Data -
Pin 1 Blue/Black	= Receive Data +
Pin 11 Green	= Not Used
Pin 3 Green/Black	= Not Used
Pin 14 Red	= Power Return
Pin 15 Brown	= Power Return
Pin 7 Red/Black	= Power
Pin 2 Yellow/Black	= 1PPS +
Pin 10 Yellow	= 1PPS -

lightning_arrestor_2L1M1DC48

Figure 30: Lightning Arrestor DS109-10129H-A – Wiring



Pin 1 Brown/Black	= Power
Pin 2 White	= Transmit Data -
Pin 3 White/Black	= Transmit Data +
Pin 4 Blue	= Receive Data -
Pin 5 Blue/Black	= Receive Data +
Pin 6 Green	= Not Used
Pin 7 Green/Black	= Not Used
Pin 8 Red	= Power Return
Pin 9 Brown	= Power Return
Pin 10 Red/Black	= Power
Pin 11 Yellow/Black	= 1PPS +
Pin 12 Yellow	= 1PPS -

Pin 8 Brown/Black	= Power
Pin 12 White	= Transmit Data -
Pin 4 White/Black	= Transmit Data +
Pin 9 Blue	= Receive Data -
Pin 1 Blue/Black	= Receive Data +
Pin 11 Green	= Not Used
Pin 3 Green/Black	= Not Used
Pin 14 Red	= Power Return
Pin 15 Brown	= Power Return
Pin 7 Red/Black	= Power
Pin 2 Yellow/Black	= 1PPS +
Pin 10 Yellow	= 1PPS -

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Chapter 4

HPD Remote Site Configuration

This chapter details configuration procedures relating to High Performance Data (HPD) remote site.

4.1 Configuration Overview

The as-built documentation for your system provides guidelines for programming the equipment at an High Performance Data (HPD) remote site. The as-built documentation provides the settings for all parameters of the equipment at the site. Using this documentation as your programming aid ensures that you program the devices to a known baseline. The Configuration/Service Software (CSS) default settings provide typical values that are suitable for many sites.

IMPORTANT:
If you load a configuration file that changes the system IP address on an MNR router or GGM 8000 gateway, the SNMPv3 credentials must be re-established with that device. Therefore, if SNMPv3 users were configured on the router or gateway before the system IP address change, issue the ResetV3 command to reset the SNMPv3 data, then reconfigure the SNMPv3 users with the appropriate privilege levels. For more information, see "Configuring MNR Routers and GGM 8000 Gateways for SNMPv3" section in the *SNMPv3* manual.

Do not deviate from the specified settings without following the proper change procedures for your organization. If a problem arises due to programming, not following proper change procedures makes troubleshooting more difficult.

NOTICE: Locate the IP address and physical address for each of the HPD Base Radios and HPD Site Controller modules before performing these procedures. Contact your system administrator for this information.

4.2 Configuring an HPD Site

The following process provides general guidelines for configuring the equipment at a High Performance Data (HPD) site.

Process:

1. Configure records for the HPD remote site and its components in te hUnified Network Configurator (UNC). The following records must be created and configured for each HPD site in the zone.

   HPD site

   HPD Site Controller (HPD SC)

   Two records are automatically created when site record is added.

   HPD channel

   HPD Base Radio (HPD BR)

   The record is automatically created when a channel is added.

2. Motorola Solutions pre-configures the site routers and site gateways before shipping.
3. Set the IP address and physical address for each of the HPD BRs and HPD SC modules using a direct serial connection with Configuration/Service Software (CSS).

4 Transfer and install software to the equipment at the HPD remote site using Software Download Manager.

NOTICE: Motorola Solutions installs all software before shipping the equipment to the intended installation site. Software Download Manager is used to transfer and install software updates to devices in the HPD remote site as needed.

5 Configure the HPD SC settings through CSS. See: Configuring the HPD Site Controller Settings through CSS on page 66.

6 Configure the HPD BR settings through CSS. See: Configuring the HPD Base Radio Settings through CSS on page 66.

7 Configure the MOSCAD NFM monitoring device. See: Configuring the MOSCAD NFM Monitoring Device on page 67.

4.2.1
Configuring the HPD Site Controller Settings through CSS

Prerequisites: Perform Configuring an HPD Site on page 65.

Procedure:

1 Connect Configuration/Service Software (CSS) with the active HPD Site Controller (HPD SC) through an Ethernet connection.

2 Configure the channels, band plan, and switch settings.

3 Write the data to the HPD SC.

4 Check the status report and status panel to verify that the HPD SC and its components are operating properly.

5 Check the GNSS information screen and verify the values. Press the **Refresh** button to get current GNSS values.

6 Through a serial connection, initiate the battery equalization for the HPD SC using CSS.

7 Reset the HPD SC so the other SC becomes active.

8 Configure the new active SC in the same manner.

4.2.2
Configuring the HPD Base Radio Settings through CSS

Prerequisites: Perform Configuring an HPD Site on page 65.

Procedure:

1 Connect Configuration/Service Software (CSS) with the HPD Base Radio (HPD BR) through an Ethernet connection.

2 Configure the HPD BR settings, including the transmit/receive frequencies, band plan settings, battery type, and GTR 8000 configuration (standalone, site subsystem, or expandable site subsystem).

3 If the HPD BR is in a site subsystem or expandable site subsystem rack, set the attenuation on the Receive Multicouplers (RMCs) according to the values in the **RMC Configuration** tab.

4 Press the **Validate HW Configuration** button to verify that the hardware configuration is valid. A success or error message displays.

5 Change the mode from **Configuration** to **Normal**.

6 Write the data to the HPD BR.

7 Check the status report and status panel to verify that the HPD BR and its components are operating properly.

8 Initiate a battery alignment in CSS.

9 Set the HPD BR to Service mode.

10 Initiate tests and measurements for BER and RSSI using HPD patterns (connect with a service monitor).

11 Set the HPD BR with the appropriate channel number through CSS.

12 Set the date and time through CSS.

13 Set the HPD BR to the **Normal** mode.

4.2.3
Configuring the MOSCAD NFM Monitoring Device

Prerequisites: Perform Configuring an HPD Site on page 65.

Procedure:

1 Set jumpers for any digital inputs used on the device.

2 Ping the MOSCAD NFM device to verify that it is available on the network.

3 Download the application and configuration into the MOSCAD NFM device.

4.3
Software Download

High Performance Data (HPD) Site Controllers and HPD Base Radios (HPD BRs) are preloaded with software before being shipped from the factory. If additional devices are added to the site or if the software needs to be upgraded, use the Software Download Manager to transfer and install the software.

The HPD Site Controllers (HPD SCs) and BRs each have an active and inactive memory bank. A software transfer is a background process that does not affect system operation. During the transfer, software is loaded into the inactive memory bank of the device. The HPD SCs act as proxy devices for the HPD BRs, so any transfers for the BRs are first loaded into the HPD SCs, which then transfer the software into the BRs at the site.

When the install option is selected, a device resets and initializes using the new software. The old software remains in the inactive memory bank. A successful transfer and installation process may take between 20 minutes and one hour, depending on the number of channels at the site.

Version information, installed files, and other information for both the active (running) software and inactive software can be viewed through the Software Download Manager.

4.4
Site Controller Configuration for HPD Operation

To configure the Site Controller for High Performance Data (HPD) operation, you need to set a number of parameters in the HPD Site Controller (HPD SC).

For information on the parameters that must be configured for HPD operation in each Site Controller, see the *GCP 8000 Site Controller* manual. The parameters in the Configuration/Service Software (CSS) include default parameters which provide a baseline that may be suitable for typical sites. When configuring the HPD SC modules, see the configuration recommendations provided by the system engineering.

NOTICE: Only the active HPD Site Controller can be configured. When reading the configuration from the standby HPD SC, all the parameters are read-only. If the standby HPD SC needs to be configured, reset the active HPD SC to cause a switchover.

Frequency Band Plan

The frequency band plan elements must be configured and enabled for the 700 MHz and 800 MHz band plans, as appropriate. The default settings should be used for the band plan elements, as shown in the following table. In the Unified Network Configurator (UNC), the appropriate band plan element must be configured for each HPD channel in the Implicit Band Plan Element field.

Channel

Each channel at the site should be shown with the appropriate configuration in the **Channel** screen.

Power Supply Type

Selects the type of power supply that is used with the HPD SC. This parameter should be set to AC/48 VDC. The actual type of power supply that the HPD SC is using can be seen through CSS.

Battery Type

If any type of backup battery is connected to the HPD SC chassis, it should be selected through this field.

Site Controller Switch

These settings define the port configuration for the internal HPD SC switch that is used to connect with HPD BRs, MOSCAD NFM, and the site router or site gateway. Port 20 in the HPD SC is used as the communication path between the SCs. This path is used by the SCs to determine the operational status of the other SC at the site, for Software Download Manager, and for other purposes. The requested port speed for port 20 should be configured for 100 Mbps Full-Duplex. Once the port is configured to match the specific network configuration, the configuration values for Port 20 should not be changed unless there is a change in the network configuration at the site. The specific site configuration determines if this port is enabled or disabled. A description of when Port 20 should be enabled or disabled is provided.

Port 20 should be enabled under the following configurations:

- HPD Standalone Site – Single Path
- HPD Standalone Site – Dual Path
- HPD Overlay at ASTRO® 25 Repeater Site – Single Path
- HPD Overlay at previously installed Simulcast Remote Site
- HPD Overlay at Simulcast Remote Site
- HPD Overlay at previously installed Simulcast Prime Site – Single Path
- HPD Overlay at Simulcast Prime Site – Single Path

Port 20 should be disabled under the following configurations:

- HPD Overlay at ASTRO® 25 repeater site – Single Path – Dual LAN Switches
- HPD Overlay at ASTRO® 25 repeater site – Dual Paths
- HPD Overlay at Previously Installed Simulcast Prime Site – Dual Path
- HPD Overlay at Simulcast Prime Site – Dual Path
- HPD with GTR 8000 IV&D – Single Path
- HPD with GTR 8000 IV&D – Dual Path

Table 7: Frequency Band Plan Element Settings

Setting	Band Plan Element 1	Band Plan Element 2
Band Plan ID number	1	2

Table continued…

Setting	Band Plan Element 1	Band Plan Element 2
Frequency band	800 MHz	700 MHz
Base TX frequency	851.012500 MHz	764.012500 MHz
Channel bandwidth	25 kHz	25 kHz
Channel spacing	6.25 kHz	6.25 kHz
TX to RX offset	-45 MHz	30 MHz

For more information on HPD configuration, see the following ASTRO® 25 system manuals and online help:

- *GCP 8000 Site Controller* manual
- *GTR 8000 Base Radio* manual
- *GTR 8000 Expandable Site Subsystem* manual
- CSS online help

4.5 Base Radio Configuration for HPD Operation

The following parameters must be configured in the High Performance Data (HPD) Base Radio through the Configuration/Service Software (CSS). The parameters in the CSS include default parameters that provide a baseline that may be suitable for typical HPD Base Radios (HPD BRs). See the configuration recommendations provided by the system engineering when configuring the HPD BR.

CAUTION: Changing Base Radio parameters can have a serious impact on performance. See the configuration recommendations provided by system engineering when configuring the HPD BR. Do not deviate from specified settings without following the proper change procedures for your organization.

Transmitter Frequency Band

The BR must be configured for the 700 MHz or 800 MHz frequency band. The transmit frequencies in the 700 MHz band consist of frequencies in the 746.0125 – 775.9875 MHz range. For the 800 MHz band, transmit frequencies are in the range of 851.0125 – 869.9875 MHz. This field automatically sets the receive frequency band parameter.

Pilot/Sync Code Set

This parameter defines the pilot/sync code set that is used on this channel. This parameter should only be changed to address severe interference problems from other adjacent sites. Otherwise, the default setting should be used.

Maximum Random Access Attempts

This parameter indicates the maximum number of random access attempts that an MSU should try on this channel. The BR periodically broadcasts this value to the MSU population.

Random Access Response Timer

This timer is broadcast to the MSU population to indicate the amount of time that an MSU should wait for a response from the BR before considering that a random access attempt has failed.

Wait for Cluster Timer

This parameter defines the wait for cluster timer that is advertised to the MSUs on the channel.

Back-off Algorithm

This value is advertised to the MSUs on the channel to indicate the back-off algorithm that should be used after unsuccessful random access. The MSUs use the back-off algorithm to prevent congestion by determining how many random access clusters should be skipped before retrying a random access message over the channel.

Open Loop Access Parameter
This field indicates the power adjustment parameter advertised to MSUs on the channel. MSUs on the channel adjust their transmit power by measuring the RSSI of the BR and by the values of the Open Loop Access Parameter (OLAP) and Maximum MSU Transmit Power (MMTP) values.

Maximum MSU Transmit Power
This value is advertised to MSUs to indicate the maximum transmit power that the MSU may use on this channel.

Tx Power Out
This parameter requests the transmit power that should be supplied by the channel PA. CSS also displays the actual transmit power output for the BR.

Tx Power Level Battery Backup
This parameter indicates the transmit power to be used by the BR when running on battery backup. When running with battery backup, CSS also displays the actual power level being output by the BR.

Power Supply
This field indicates the type of power supply being used on the BR.

Frequency Reference
Specifies the source of the frequency reference for the station.

Battery Type
This field indicates the type of storage battery used so the power supply circuitry can select the best charging rate. Whenever AC power is lost, the Base Radio uses the Tx Power Level Battery Backup value.

Illegal Carrier Determination
The illegal carrier determination feature allows the BR to detect and respond to unrecognized signaling on the channel that exceeds a particular threshold for at least a certain amount of time. This feature can be enabled or disabled through this parameter.

RF Threshold Value
The RF threshold parameter determines the minimum RF signal level that is recognized before classifying an illegal carrier event and reporting an alarm to the Unified Event Manager (UEM).

Malfunction Timer Value
When Illegal Carrier Determination is checked, this field allows you to specify the length of time (in seconds) a signal must continuously exceed the RF Threshold before being reported as an illegal carrier.

Chapter 5

HPD Remote Site Optimization

There are no optimization procedures for the High Performance Data (HPD) remote site.

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Chapter 6

HPD Remote Site Operation

There are no operational procedures relating to the High Performance Data (HPD) remote site.

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Chapter 7

HPD Remote Site Maintenance

There are no periodic maintenance procedures relating to the High Performance Data (HPD) remote site.

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Chapter 8

HPD Remote Site Troubleshooting

This chapter provides the fault management and troubleshooting information relating to the High Performance Data (HPD) remote site.

8.1 HPD Remote Site Failures

The following table explains the impact, potential causes, and steps for identifying problems with links and devices at the High Performance Data (HPD) remote site. In general, site link failures and site router or site gateway failures cause the HPD remote site to become isolated from the master site, unless a secondary router or secondary gateway and site link is supported at the site. Depending on the failure scenario and site configuration, problems with the HPD Site Controllers may cause a switchover, site isolation, or have no affect on HPD services. Problems with individual HPD Base Radios cause the channel to become unavailable at the site, and the HPD Site Controller utilizes the remaining channels (if possible) with a decreased total site capacity.

In all cases, Mobile Subscriber Units (MSUs) attempt to remain in wide area mode. A number of hold off timers for the site determine the length of time that MSUs may require when transitioning between sites during failure and recovery scenarios. The hold off timers are defined in the Unified Network Configurator (UNC) and include:

- FRHOT
- RRHOT
- CAHOT

Table 8: HPD Remote Site Failures

Failure	Impact	Potential Causes	Troubleshooting
Site link failure	• If a backup site link is connected to the site, it becomes active. The new path consists of the backup link from the core, the backup site router or backup site gateway, and the secondary HPD SC. The site control debounce time setting in the UNC defines how long the system waits before attempting to reinitialize a failed site control path. • If a backup link is not installed, the site enters local mode and	• Cable disconnected • Microwave link failure • Problems with site link path (site router or site gateway, or service provider).	Check the status and alarms for the site router or site gateway, and other related components using the Unified Event Manager (UEM). Try to isolate the problem to one of the potential causes that are listed and correct the problem.

Table continued…

Failure	Impact	Potential Causes	Troubleshooting
	no HPD service is available at the site. MSUs attempt to find a wide area site.		
Site router or site gateway failure	• If a backup router or backup gateway and site link is connected to the site, it becomes active. The new path consists of the backup link from the core, the backup site router or backup site gateway, and the secondary HPD SC. • If a backup link is not installed, the site enters local mode and no HPD service is available at the site. MSUs attempt to find a wide area site.	• Failed router (or gateway) or failed daughterboard • Configuration problem • Bad connection	Check for alarms and configuration problems using the UEM. Check router or gateway LEDs and replace the router or gateway or failed I/O modules as necessary.
Primary HPD SC failure (with no redundant site router or redundant site gateway)	If the primary HPD SC fails, its internal switch may or may not also fail. If the switch fails and the standby HPD SC becomes isolated, then the site enters local mode and no HPD services are available. If the switch does not fail, the standby HPD SC becomes active. MSUs have to register again with the system.	• Failed SC module • Configuration problem (multiple device IDs or active Site Controller contention) • Loss of connection with BRs	Check the status and alarms for the HPD SC and related devices using UEM. Isolate the problem to the HPD SC or site router or site gateway if possible. Verify that the backplane is configured for communication between the HPD SC modules in Configuration/ Service Software (CSS), if possible. Configuration problems can possibly be detected remotely. Check LEDs and replace any failed components as necessary.
Secondary HPD SC Failure (with no redundant router or gateway)	If the HPD SC was in standby mode, then HPD services are not affected. If the failed HPD SC was in active mode, then a switchover to the primary HPD SC takes place. MSUs have to register again after the primary SC becomes active.	• Failed SC module • Configuration problem (multiple device IDs or active Site Controller contention) • Loss of connection with BRs	Check the status and alarms for the HPD SC through UEM. Check LEDs and replace any failed components in the HPD SC chassis necessary.

Table continued…

Failure	Impact	Potential Causes	Troubleshooting
Link to HPD BR Failure	If the HPD SC cannot communicate with the HPD BR, then the HPD BR dekeys and becomes unavailable for HPD service. MSUs move to another channel at the site if possible. If the HPD BR was the home channel, the ZC assigns another home channel. If the HPD SC cannot access any BRs, then a switchover occurs.	• Failed Base Radio or failed components • Port configuration problem in HPD SC • Unplugged cable	Check the status and alarms for the HPD SC, HPD channel, and HPD BR through the UEM. Verify the port configuration in the HPD SC through CSS. Check LEDs and replace any failed components in the HPD SC or HPD BR if necessary.

8.2
Illegal Carrier Detection

The High Performance Data (HPD) Base Radios are equipped with illegal carrier detection functionality to identify when an interfering carrier signal is operating within the channel space of the HPD Base Radio (HPD BR). The HPD BR classifies an illegal carrier event by a minimum signal threshold level and a minimum duration as defined by the parameters in Configuration/Service Software (CSS).

If a continuous interfering carrier signal is detected (greater than the threshold level for a length of time beyond the duration timer), the HPD BR declares an illegal carrier state. The HPD BR clears an illegal carrier state as soon as the carrier signal falls 1.5 dBm below the illegal carrier threshold level.

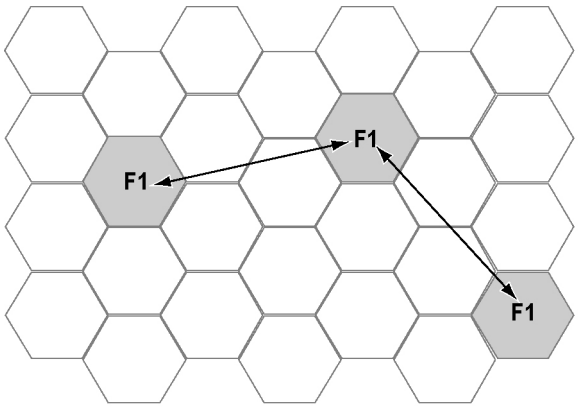
Upon detection of an illegal carrier state, the HPD BR reports the state and the signal-noise level to the Unified Event Manager (UEM) as a transient fault. Additionally, the illegal carrier conditions are logged locally in the HPD BR and may be viewed through CSS. The HPD BR remains operational during the illegal carrier condition.

This function only detects interfering signaling, and does not detect illegal traffic on the channel.

8.3
Co-Channel Interference

High Performance Data (HPD) channels use scrambling codes to permit rejection of co-channel signals by using different scrambling codes in areas where the coverage may overlap. The interfering channel may be part of another radio system in the same general area or may be part of the same radio system depending on the frequency reuse plan. The scrambling code used at a site is identified by the Color Code setting (read-only) in the **HPD Site** record in the Unified Network Configurator (UNC).

Figure 31: Co-Channel Interference



HPD_co_channel_interference

8.4

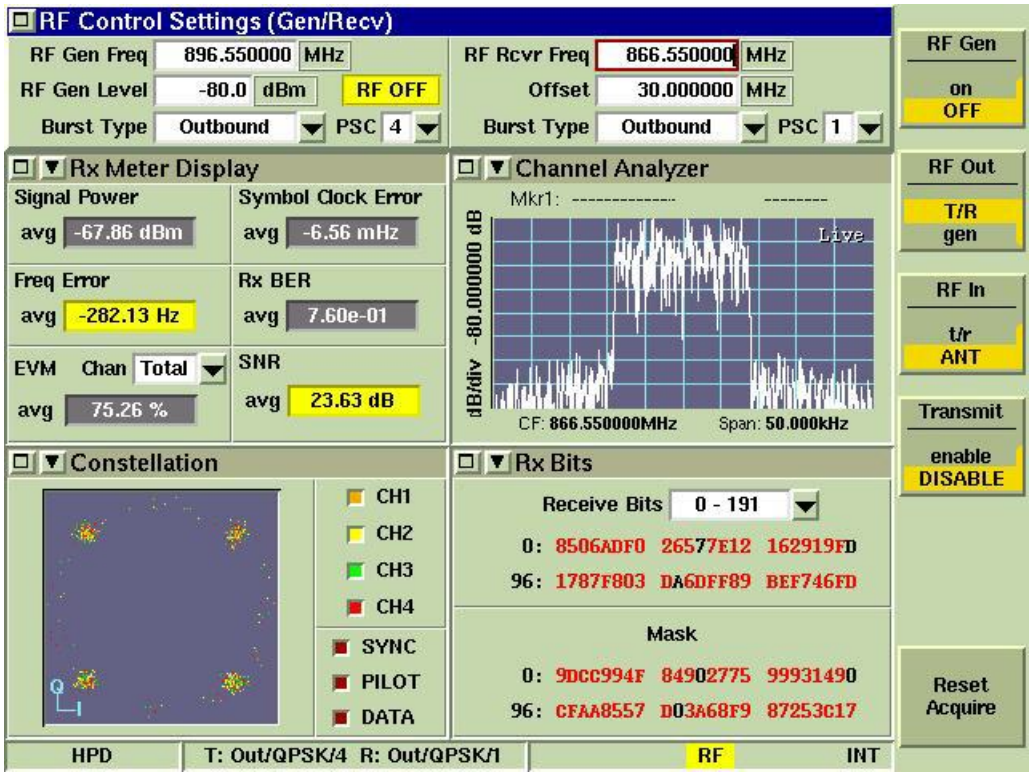
HPD Service Monitor

The High Performance Data (HPD) service monitor is a diagnostic tool that may be used with an HPD Base Radio (HPD BR) or HPD modem to test and measure the transmitter and receiver characteristics. The HPD service monitor can generate HPD signaling and can provide diagnostic information for received signaling.

You can perform the following operations with the HPD service monitor:

- View received signal measurements (signal power, clocking error in received signal, frequency error, signal-to-noise ration, bit error rate, and error vector magnitude).
- View magnitude/phase error estimation for a received signal from the HPD BR.
- View the data stream of received bit blocks for message bursts from the HPD BR.
- View constellation, trajectory, error vector magnitude, eye diagram, and I&Q time display for the modulated BR signal.
- View power profile or ramps profile showing the first and last milliseconds of a burst.
- Capture an XML file of raw data service to a connected PC. This file shows processing instructions, time stamps, headers, and data blocks of traffic bursts from the HPD BR.

Figure 32: HPD Service Monitor – Test Screen



The HPD service monitor may be connected with an HPD BR or HPD modem to perform the following diagnostic tests. These tests are designed to determine whether the equipment is operating within specification. If the HPD BR fails to meet the specification, service may be required on the BR.

- Measure Transmit Power
- Measure Frequency Accuracy
- Measure Bit Error Rate (BER) for Transmitter and Receiver
- Measure Receiver Sensitivity

See the test and measurement instructions for the HPD BR for additional information. Also see the HPD service monitor manual or online help for additional information about using the service monitor. See the following ASTRO® 25 system manuals for the diagnostic tests:

- *GTR 8000 Base Radio* manual
- *GTR 8000 Expandable Site Subsystem* manual

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Chapter 9

HPD Remote Site FRU/FRE Information

This chapter lists the Field Replaceable Units (FRUs) and Field Replaceable Entities (FREs) and includes replacement procedures applicable to the High Performance Data (HPD) remote site.

9.1 FRU/FRE Information

For lists of Field Replaceable Units (FRUs) and Field Replaceable Entities (FREs) and replacement procedures applicable to the High Performance Data (HPD) remote site, see the documentation for the particular components.

- *S6000 and S2500 System Routers* manual
- *GCP 8000 Site Controller* manual
- *GTR 8000 Base Radio* manual
- *GTR 8000 Expandable Site Subsystem* manual
- *GGM 8000 System Gateway* manual

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Chapter 10

HPD Remote Site Reference

This chapter contains supplemental reference information relating to the High Performance Data (HPD) remote site.

10.1 Reference

This section provides sources for supplemental reference information related to the High Performance Data (HPD) remote site.

For reference information for specific site devices, see the following manuals:

- *S6000 and S2500 System Routers* manual
- *GCP 8000 Site Controller* manual
- *GTR 8000 Base Radio* manual
- *GTR 8000 Expandable Site Subsystem* manual
- *GGM 8000 System Gateway* manual

No additional reference information is required for the remote site in an HPD system. For more information, see the following related manuals:

- *HPD Overlay System Infrastructure* manual
- *HPD Standalone Master Site* manual
- *HPD Standalone System* manual
- *HPD Standalone System Infrastructure* manual

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