LGC WIRELESS

LGCell™

Installation and Reference Manual

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LGC Wireless

LGC Wireless is a leading supplier of wireless solutions that enable mobile voice and data communications and wireless Internet access throughout any facility. The company's wireless system, the LGC*ell*™, provides mobile users with highly reliable access to high-quality voice and wireless data via cellular and PCS networks throughout any private (corporation, university, hospital) or public (airport, convention center, subway) facility.

LGC Wireless has received all type approvals for the LGC*ell*, including the European CE Mark, and is currently shipping product to more than 12 countries. The LGC*ell* supports all global wireless access standards including TDMA, CDMA, AMPS, GSM and iDEN. LGC Wireless also offers a full range of professional services to ensure cost effective and timely deployment of wireless networks.

Your comments can assist us in improving our products and documentation. Please address them to LGC Wireless, Inc.

LGC Wireless, Inc.

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LGC*ell* Installation Procedure

This section shows the steps involved in installing an LGC*ell* system.

For a detailed description of LGC*ell* installation procedures, refer to *Section 4, LGCell Installation*.

If you plan to connect your LG*Cell* system to more than one radio or base station, you also need the *Integration Module Installation and Reference Manual*.

Install LGC*ell* equipment in the wiring, telecom, or electrical closet(s) indicated on your site installation plan. LGC Wireless provides the following equipment and supplies for installation:

* LGC*ell* Main Hub(s), each with two rack mount elbow brackets and four rack mount screws
* LGC*ell* Expansion Hub(s), each with two rack mount elbow brackets and four rack mount screws
* Remote Antenna Unit(s) (RAUs) and in-building antenna(s), with four mounting screws for each RAU
* *LG*Cell *Installation and Reference Guide*
* Optionally, *Integration Module Installation and Reference Manual*

You also need the following equipment and supplies:

* Cable and connectors already installed and terminated. LGC Wireless recommends plenum-rated Category 5 (CAT 5) or better, Unshielded Twisted Pair or Shielded Twisted Pair (UTP/STP) and Multi-Mode Fiber (MMF) cable.
* AC power supply (100-240 VAC at 1.6 A and 50/60 Hz) available for each Main Hub
* 19" equipment rack space in the wiring closet
* Phillips screwdriver
* MMF cleaner recommended by the cable manufacturer

Inspect the equipment and supplies before you start the LGC*ell* installation. Make sure that the UTP/STP and MMF cables are terminated correctly and that the connectors are clean and free of dust or oil (use recommended cleaner as necessary). If you have any problems, call LGC Wireless at 1-800-530-9960 (U.S. customers) or +1-408-487-2400 (international customers).

The procedure for installing the LGC*ell* system follows. *Section 4, LGCell Installation*, describes the installation procedure in detail.

A. Main Hub Installation

1   Mount one or more LG*Cell* Main Hubs in an equipment rack in the assigned wiring closet location, using the four screws provided for each hub.

2   Connect the AC power to each Main Hub and power up the hub.

3   Connect two clean MMF cables to each Main Hub port.

4   Check the Main Hub Sync and Link Status LEDs (connected = green, not connected = red).

5   Connect the RF cable from the antenna(s) to the Main Hub(s) (for a roof-mounted antenna, insert a lightning arrestor or surge protector).

B. Expansion Hub Installation

1   Mount one or more LG*Cell* Expansion Hubs in the equipment rack, using the four screws provided for each hub.

2   Connect the AC power to each Expansion Hub and power up the hub.

3   Connect all MMF cables from the Main Hub(s) to the Expansion Hub(s).

4   Check the Expansion Hub Sync and Link Status LEDs (connected = green, not connected = red)

5   Connect CAT 5 cable to the respective ports

C. RAU and Antenna Installation

1   Mount the RAU(s) and antenna(s).

2   Connect the UTP/STP cables from the Expansion Hubs to the RJ-45 connectors on the RAU(s).

3   Connect an accessory antenna to each RAU SMA connector.

4   Check the LEDs on the RAU(s). If not connected properly or sync is not achieved, then one LED will be red. When connected, one LED should be green and the other not lit.

D. System Monitoring using the ARM (if provisioned)

1   Install the Alarm Report Monitor (ARM) panel adjacent to the Main Hubs.

2   Connect the octopus cable to the connector on the ARM.

3   Connect one DB9 connector from the octopus cable to each ARM unit.

4   Set the dip switch in the ARM to the appropriate ID number.

5   Connect the ARM unit to a local PSTN line.

6   Install the ARM system software on a PC at the NOC.

7   Configure the software and dial into the ARM unit to set its parameters (dial-in number, and so on).

About This Manual

This *Installation and Reference Manual* describes the following LGC*ell* products:

- LGC*ell* 800 MHz AMPS/TDMA/CDMA/iDEN
- LGC*ell* 900 MHz GSM
- LGC*ell* 1800 MHz DCS
- LGC*ell* 1800 MHz Korean PCS
- LGC*ell* 1900 MHz TDMA/CDMA/GSM
- LGC*ell* Dual Band 900 GSM/1800 DCS

System operation for these products is identical. The only differences between the products are the operating frequency range, access scheme (TDMA, GSM, etc.) and certain operating parameters (gain, etc.). In this manual, distinctions between different systems are clearly indicated.

This section provides an overview of this *Installation and Reference Manual*, describes conventions, and provides other useful information.

If you plan to connect your LG*Cell* system to more than one radio or base station, you also need the *Integration Module Installation and Reference Manual*.

Overview

This manual provides information to prepare for and install the LGC*ell* equipment. The following steps need to be taken:

- RF engineering and system design
- Equipment purchasing
- Cable preparation
- Equipment installation and commissioning

This manual has six sections and five appendixes:

1 About LGC*ell*   Describes the LGC*ell's* functions, applications, components and its advantages.

2 LGC*ell* Equipment   Describes the standard LGC*ell* equipment and operation and provides System Specifications.

3 LGC*ell* Site Planning and Design   Contains information about pre-installation preparation and project management from site planning through LG*Cell* installation. The tasks involved and an estimated timetable are provided.

4 LGC*ell* Installation   Describes system requirements, lists standard equipment, and gives LGC*ell* equipment installation procedures.

5 Connectivity   Contains Maximum Input/Output RF Power and RF Power per Carrier tables and describes how to connect multiple LGC*ell* systems.

6 Common Problems, Troubleshooting, and Frequently Asked Questions   Describes how to diagnose and solve operational problems and gives answers to questions that customers ask frequently.

Appendix A – Cables, Connectors and Accessories   Contains information about cables, connectors, and accessories for LG*Cell* applications.

Appendix B – TIA/EIA 568-A Cabling Standards   Contains information about standards for in-building cabling.

Appendix C – Compliance Information   Provides system approval status and regulatory notices for various countries.

Appendix D – Services   Lists the services that LGC Wireless can provide for customers.

Appendix E – Alarm Report Monitor (ARM2000)   Describes the ARM2000 system, which can be used to monitor LG*Cell* alarms.

Terminology

This manual uses the following acronyms.

Acronym	Description
AMPS	Advanced Mobile Phone System
ARM	Alarm Report Monitor
BTS	Macrocellular base station
CAT 5	Category 5 unshielded or shielded twisted pair cable
CDMA	Code Division Multiple Access
EH	Expansion Hub
GSM	Global Systems for Mobile Communications
iDEN	integrated Digital Enhanced Network
IM	Integration Module
LED	Light emitting diode
MBS	Microcellular base station
MH	Main Hub
MMF	Multi-mode fiber
PCS	Personal Communications Services
RAU	Remote Antenna Unit
RF	Radio Frequency signals
TDMA	Time Division Multiple Access
UTP/STP	Unshielded twisted pair or shielded twisted pair (cable)

Conventions

This manual uses the following conventions as described:

Words in *italicized* type	Used for cross-references to other places in the manual
Words in **boldface** type	Used for emphasis
Words in THIS TYPEFACE	Identifies labels on Main Hubs, Expansion Hubs, and Remote Antenna Units

LGC WIRELESS

This manual uses the following symbols as described.

This symbol represents additional INFORMATION.

It is used to emphasize text with unusual importance, special
significance, or to provide supplemental information.

This symbol represents CAUTION.

It alerts users that a given action or omitted action can cause or
contribute to a hazardous condition. Damage to the equipment can
occur.

This symbol represents WARNING.

It appears when a given action or omitted action can result in
catastrophic damage to the equipment or cause injury to the user.

Precautions

This section describes general safety precautions for LGC*ell* products and safety
precautions for Fiber Ports on the hubs.

General Safety Precautions

The following precautions apply to LGC*ell* products.

- LGC*ell* has no user-serviceable parts. Faulty or failed units are fully
  replaceable through LGC Wireless. Please contact us at 1-800-530-9960. For
  international customers, please contact us at +1-408-487-2400.

- Never input an RF signal to the Main Hub Duplex port that is higher than those
  defined on page 17 in *Section 2, LGCell Equipment*.

- Although modeled after an Ethernet/LAN-like architecture and connectivity,
  LGC*ell* units (Main Hub, Expansion Hub, and the Remote Antenna Unit) are
  not intended to connect to Ethernet data hubs, routers, cards or other similar
  data equipment.

- For improved air circulation, be sure to leave at least one inch (25 mm) of
  space between all hubs and between any other equipment in the rack. If
  mounting a hub on the rack's bottom shelf, also leave at least a one inch of
  clearance from the bottom.

- When you connect the Multi-Mode Fiber (MMF) Optical Cable, take the same precaution as if installing Ethernet network equipment. All optical fiber ST connectors should be cleaned according to the cable manufacturer's instructions.

- When you connect a radiating antenna to an RAU, DO NOT over-tighten the SMA connector. Firmly hand-tightening the connector is adequate.

To reduce the risk of fire or electric shock, do not expose this equipment to rain or moisture.

Fiber Port Safety Precautions

Suggested safety precautions for working with LG*Cell* Fiber Ports follow. For information about LG*Cell* compliance with safety standards, see *Appendix C – Compliance Information*.

- **Viewing fiber:** Observe the following warning about viewing fiber ends in ports.

  Do not stare with unprotected eyes at the connector ends of the fibers or the ports of the hubs.Invisible infrared radiation is present at the front panel of the Main Hub and Expansion Hub. Do not remove the Fiber Port dust cover unless the port is in use. Do not stare directly into a Fiber Port.

- **Test fiber cables:** When you use test fiber optical cables, connect the optical power source last and disconnect it first.

- **Fiber ends:** Cover any unconnected fiber ends with an approved cap. Do not use tape.

- **Broken fiber cables:** Do not stare with unprotected eyes at any broken ends of the fibers. Report any broken fiber cables and have them replaced.

- **Cleaning:** Use only approved methods for cleaning optical fiber connectors.

- **Modifications:** Do not make any unauthorized modifications to this fiber optical system or associated equipment.

- **Live work:** Live work is permitted on the LG*Cell* as it is a Class 1 hazard.

- **Signs:** No warning signs are required.

- **Test equipment:** Use Class 1 test equipment.

1 About LGC*ell*

This section is an overview of the LGC*ell*. It gives a brief description of the system and applications, the LGC*ell* equipment, how it works, why it's better than the competition, and what you need to do to install the system.

Later sections of this *Installation and Reference Manual* contain a detailed description of the LG*Cell* system.
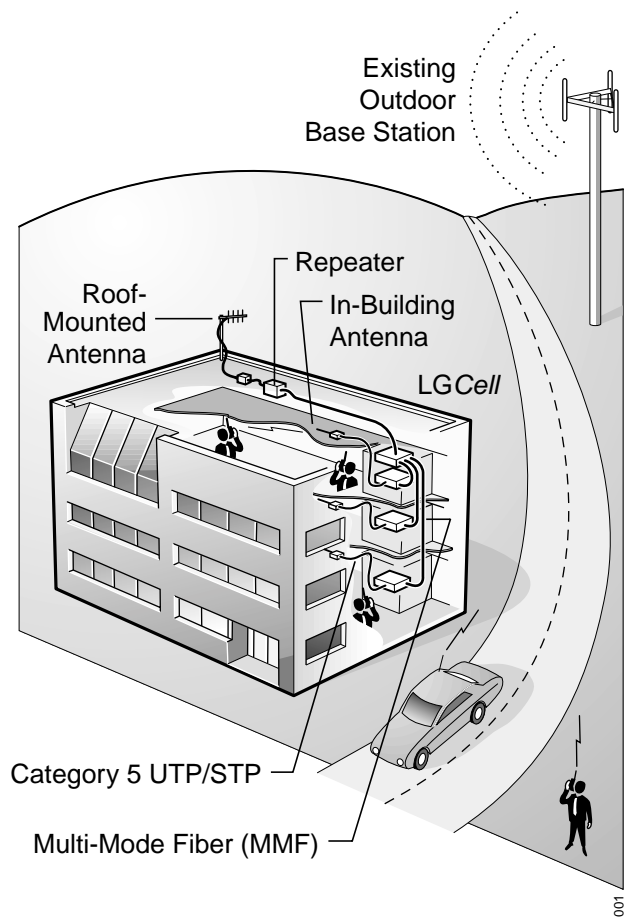
Contents

About LGCell

What LG*Cell* Is

LG*Cell* is a "plug-and-play" in-building distributed antenna system (DAS) that enables highly reliable, high-quality wireless communications.

This one-person-one-phone capability gives a wireless phone user the ability to use their wireless phone in any location throughout the enterprise and beyond.

Seamless coverage lets wireless phone users roam freely between buildings as well as indoors and outdoors without changing phones.

An LG*Cell* system has the following equipment:

- Main Hub (MH)

- Expansion Hub (EH)

- Remote Antenna Unit (RAU)

Existing Outdoor Base Station

Repeater

Roof-Mounted Antenna

In-Building Antenna

LG*Cell*

Category 5 UTP/STP

Multi-Mode Fiber (MMF)

001

Double-Star Topology for Easy, Cost-Effective Growth

The LG*Cell* system uses a double-star topology, which allows for easy, cost-effective growth of coverage and/or capacity. Each Main Hub supports up to four Expansion Hubs. Each Expansion Hub, in turn, supports up to four RAUs.

The Main Hub is located in an equipment closet and the Expansion Hubs are distributed out into other equipment closets throughout a building. The RAUs are then distributed off each Expansion Hub to provide coverage.

Bringing Outside In – Increases Wireless Network Coverage

Outdoor macrocellular base stations (BTSs) transmit and receive Radio Frequency (RF) signals, which enable communications with wireless phones. The RF signals are not always available or adequate inside a building, campus, tunnel, subway, or other hard-to-reach location. The LG*Cell* system delivers high-quality wireless

communications when a user is within range of an LGC*ell* Remote Antenna Unit (RAU).
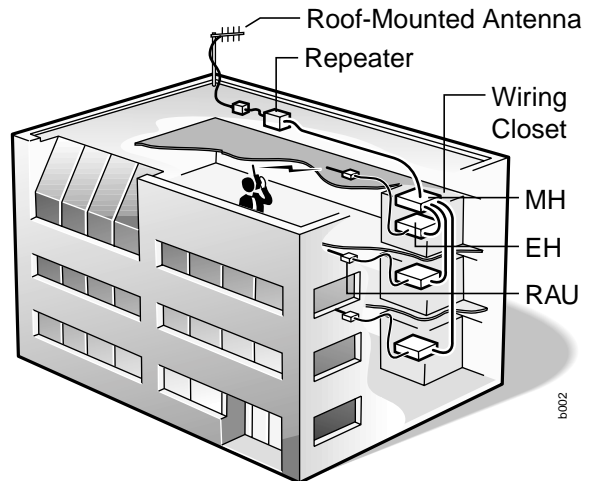
LGC*ell* Increases In-Building Coverage

LGC*ell* operates in the cellular or PCS frequency bands and can act as an extension to the cellular or PCS network.

LGC*ell* extends RF signal coverage in places where the coverage is unacceptable.

This extended coverage allows users to roam between buildings and the outside world while maintaining wireless phone conversations without changing phones.

LGC*ell* provides coverage for a variety of applications including single and multiple floor buildings, campus environments, tunnels, subways, and public facilities.

Roof-Mounted Antenna
Repeater
Wiring Closet
MH
EH
RAU

b002

LGC*ell* can be connected to a separate repeater for a power boost or when line of sight is poor.

• **Increase In-Building Coverage with Multiple LGC*ells***

Use multiple LGC*ell* systems to increase coverage in very tall buildings or large facilities.

• **Increase Coverage for Separate Service Providers**

Use one or more LGC*ell* systems for cellular networks and use one or more for PCS networks.

• **Increase Coverage for Separate Networks**

Use one or more LGC*ell* system for public networks and use one or more for private networks.

## Expanding Inside – Increases In-Building Capacity and Capability

Increased in-building wireless coverage from the outdoor wireless networks does not always fully address in-building needs. Coverage is only beneficial if all potential users can access the network.

Microcellular Base Station (MBS) for Increased Capacity

Connecting the LGC*ell* to a local, centralized MBS provides additional capacity, as well as enhanced coverage.

This in-building microcellular wireless network increases the number of in-building users able to communicate through their wireless phones.

- LGC*ell* provides coverage
- MBS provides voice channel capacity
- Protocol independent
- Calls can be charged at a flat rate versus cellular or PCS rate inside the building
- Provides completely uniform radio coverage at low cost
- MBS capacity is dynamically allocated as needed
- Maintenance and control of the wireless network are centralized
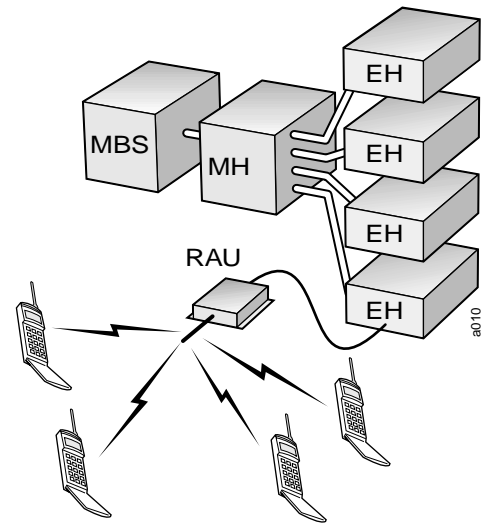
The LG*Cell*/MBS connection allocates capacity to various locations within the enterprise as user traffic patterns change over the course of a day.

### Integration Modules for Dynamic Allocation of Radio Capacity

LGC Wireless provides Integration Modules that can be used with the LG*Cell* to efficiently centralize additional radio capacity inside a facility. These Modules provide the connection between the radios for the facility and the LG*Cell* system. Because the Integration Modules distribute all available capacity automatically throughout all antennas within a cell, available capacity is dynamically allocated throughout the entire coverage area, thus providing an improved grade of service without the need to conduct ongoing traffic monitoring and analysis.

Specific installation information on all available Integration Modules is in the *Integration Module Installation and Reference Manual*.

LG*Cell*, MBS, PBX* for Increased Coverage, Capacity, and Functionality

Interfacing the LGC*ell* with an MBS/PBX network gives wireless phone users PBX functionality through their wireless phones, anytime, anywhere.

*Check with PBX manufacturer/vendor for compatibility, connection, and operation.
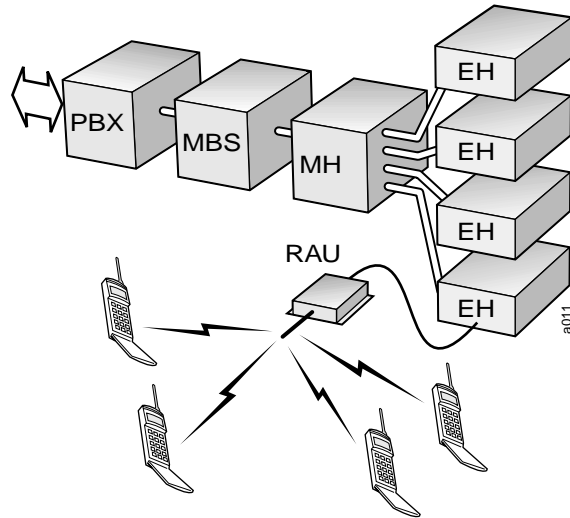
With the LG*Cell*/MBS/PBX solution, employees can use a wireless phone in place of a wireline desk phone to access the PBX while inside the building and use the same phone for wireless communications while outside the building. The MBS private wireless network transmits RF signals indoors, and the macrocellular network takes over outdoors.

- Access PBX features such as four-digit dialing, call delivery, call forwarding, call-waiting, conferencing, and voice mail

- Billed at discounted local calling rates or a flat enterprise rate for calls made inside the LG*Cell* vicinity

- Users can maintain the same telephone number inside and outside of the building, enabling anytime, anywhere communication
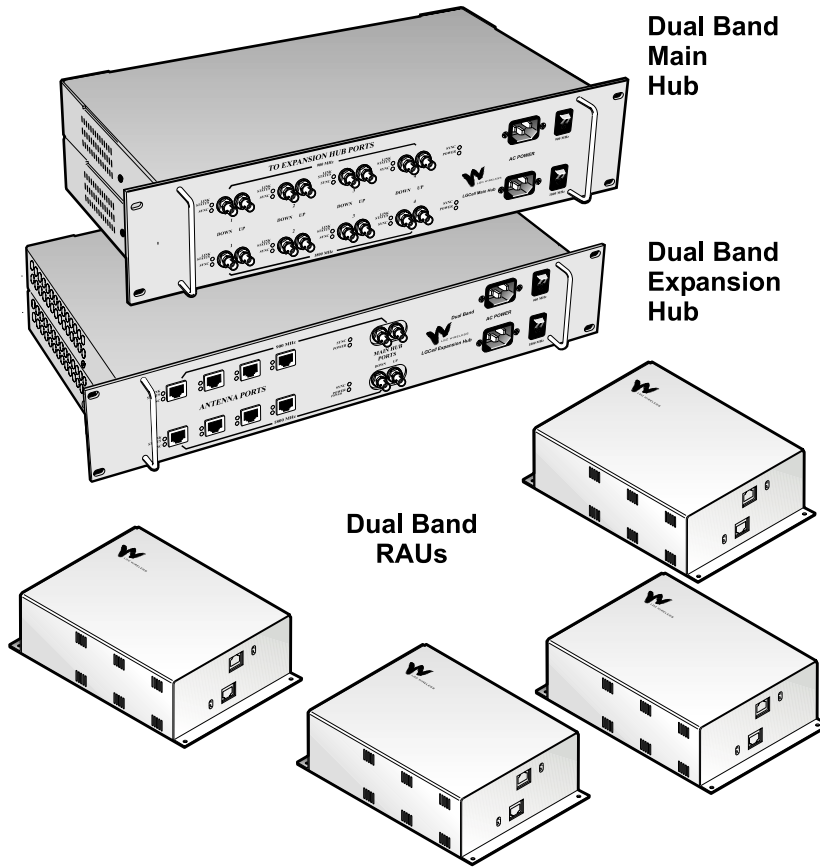
LG*Cell* Equipment
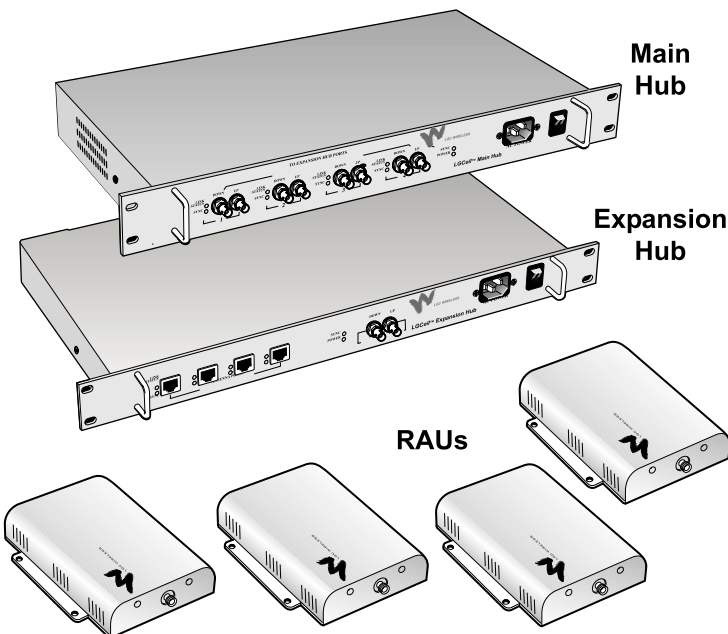
One fully equipped LG*Cell* system consists of the following parts:

- One Main Hub

- Up to four Expansion Hubs

- Up to 16 RAUs (four per Expansion Hub)

Multiple LG*Cell* systems can be stacked for various applications. (See *Section 5, Connectivity*.)

A Dual Band LG*Cell* system has two Main Hubs and at least two Expansion Hubs. A Dual Band system is a combination of single bands. The following illustration shows a Dual Band 900/1800 LG*Cell* system.

Dual Band LG*Cell* System

**Dual Band
Main
Hub**

**Dual Band
Expansion
Hub**

**Dual Band
RAUs**

The following sections provide a brief overview of *LGCell* equipment. For a detailed description of the equipment, see *Section 2, LGCell Equipment*.
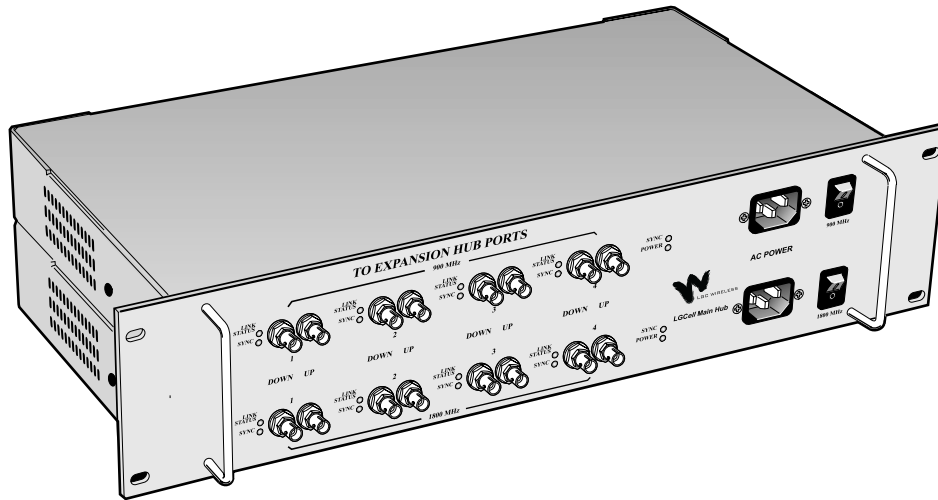
The Main Hub
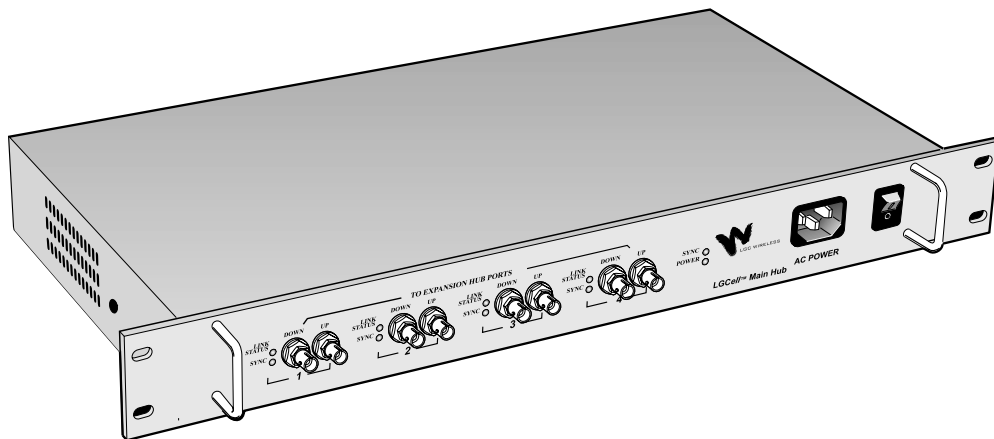
The Main Hub mounts into a standard 19" equipment rack commonly found in wiring closets or equipment rooms (Main Hub width is 17.25", or 438 mm).
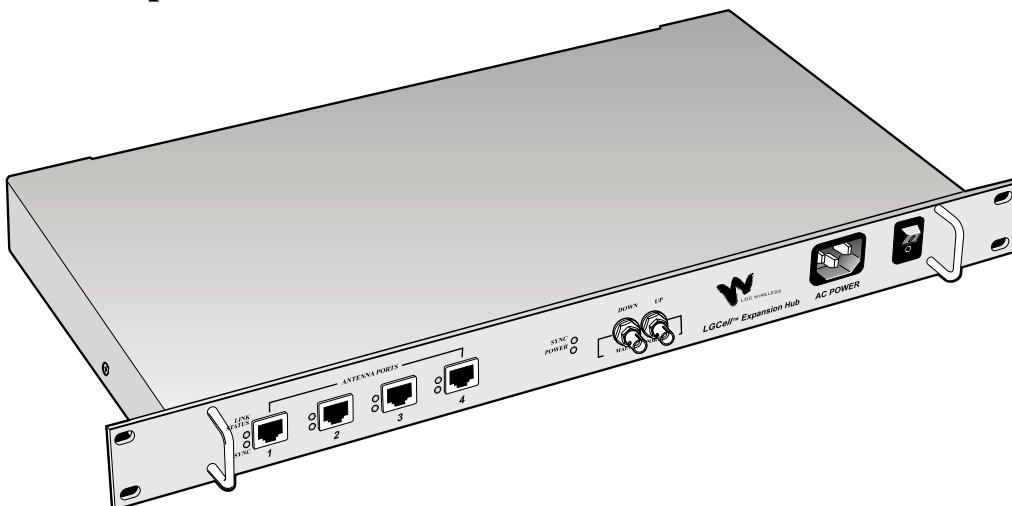
- Interfaces to the wireless network

- Height is 1.7" (44.5 mm)

- Connects to a roof-mounted antenna, repeater, or MBS via standard coaxial cable or low-loss coaxial cable with N-type male connectors

Dual Band Main Hub

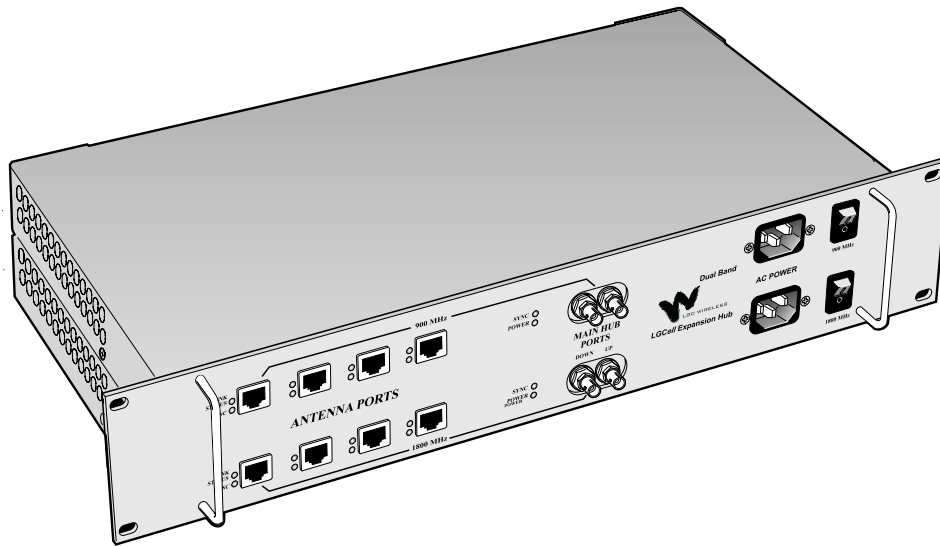The Main Hub for a Dual Band LG*Cell* system is a pair of Main Hubs, one for each band.

The Expansion Hub

The Expansion Hub also mounts into a standard 19" equipment rack (width 17.25", or 438 mm).

- Height is 1.7" (44.5 mm)

- Connects to the Main Hub via standard Multi-Mode Fiber (MMF) cable (up to 1.5 dB optical loss, approximately 1 kilometer without jumpers).

- Hubs can be located in wiring closets anywhere in the building

Dual Band Expansion Hub

An Expansion Hub for a Dual Band LG*Cell* system is a pair of Expansion Hubs, one for each band.

The Remote Antenna Unit (RAU)

The RAUs a re strategically positioned in and around a building to provide high-quality reception for wireless services.

- Connects to the Expansion Hubs via standard CAT 5 (or better) unshielded or shielded twisted pair (UTP/STP) cable (up to 60 meters) (TIA/EIA 568-A standard)

- Mounts onto a variety of building materials.
  Can be placed anywhere – above or below the ceiling, on the wall, or in other locations.

- Connects to any external antenna, dipole, directional, omnidirectional, panel, or other antenna
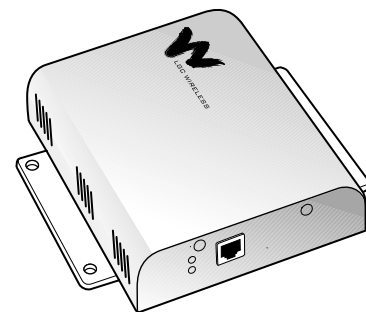
Dual Band RAU
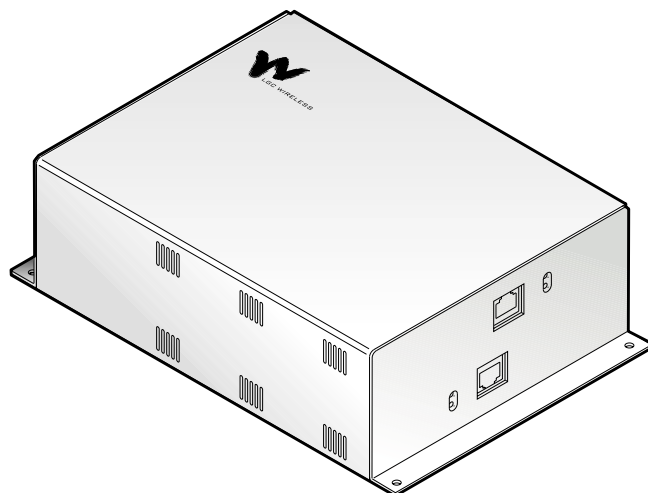
The RAU for a Dual Band LGC*ell* system is a pair of RAUs, one for each band.

How LGC*ell* Works

LGC*ell* connects in an Ethernet, LAN-like architecture, using a double-star topology. It uses proprietary technology to provide wireless access within buildings, subways, tunnels and other locations where reception is poor.

System Operation

System operation for all of the LGC*ell* DAS products is identical. The only differences between the products are the operating frequency range, access scheme (TDMA, GSM, etc.) and certain operating parameters (gain, etc.).

The Main Hub connects to an RF source:

* a roof-mounted antenna or repeater for coverage applications; or
* an MBS for capacity or wireless PBX applications, or both.

LGC*ell* distributes cellular and PCS signals through standard MMF and standard UTP/STP cable found in most buildings. This allows installation of in-building wireless services with minimal installation time and cost.

Transmit/Forward/Downlink (BTS to Phone)

The incoming RF signal into the Main Hub is split into several fiber optic transceivers that convert the RF signal to an optical signal. The Main Hub transmits the converted signal over the fiber to the Expansion Hub. The Expansion Hub converts the optical signal to an RF signal and transmits the RF signals to the RAUs. The RAUs then transmit the RF signals to the antenna and then to wireless phones.

Receive/Reverse/Uplink (Phone to BTS)

The RAUs transmit RF signals from wireless phones back through the antenna and to the Expansion Hubs. The Expansion Hubs transmit the RF signals back to the Main Hub in optical form. The Main hub converts the optical signals back to electrical signals and sends them to an MBS, a repeater, or a roof-mounted antenna. For a detailed description of system operation, see *Section 2, LGCell Equipment*.

LGC*ell* Advantages

The LGC*ell* solution is based on a fundamentally new approach that has cost and engineering advantages not found in competitive systems.

Competitive systems offer similar capabilities but require sophisticated RF engineering and take a long time to install. They typically use specialty cables that require expensive, difficult, time-consuming, and potentially disruptive installations.

LGC*ell*'s plug-and-play design requires minimal RF engineering and planning. Its unique double-star architecture keeps service and maintenance to a minimum, unlike cascaded antenna systems. The flexible architecture permits deployment in the most difficult RF environments.

LGC*ell*'s low cost and simple installation effectively provide both coverage and capacity enhancements to meet the demands of the growing wireless network.

LGC*ell* Uses Industry Standards

LG*Cell*'s use of industry standards and standard equipment offers high reliability and low cost.

- Complies with industry standards for IS-19-B/AMPS, J-std-8, IS-136/TDMA, IS-95/CDMA, ETSI 300 609-4/GSM (CE marked), and iDEN.

- Utilizes the TIA/EIA 568-A Ethernet cabling standards for ease of installation (see *Appendix A – Cables, Connectors, and Accessories).*

- Distributes signals over a building's existing industry-standard cable infrastructure of MMF and UTP/STP cable.

- Complies with UL and FCC or CE mark requirements.

- Primarily constructed with highly reliable industry-standard components produced in high-volume for the LAN and wireless industries. High quality and reliability are assured.

Minimal Design, Installation, Maintenance, and Troubleshooting

- Site engineering is simplified since compensation for cable loss and amplifiers do not need to be designed into the system, which saves precious RF Engineering time and support.

- Using standard cabling reduces installation to simple equipment mounting and cable connection.

- Centralized hub locations facilitate maintenance, upgrades, and adaptability to new standards.

- The LGC*ell*'s star configuration eases troubleshooting – it is immediately clear if an RAU is faulty.

- LGC*ell* provides full Operations Alarm Maintenance and Provisioning (OAM&P). The Main Hub senses major alarms through contact closure. These alarms can be sent to remote locations. (For information on the Alarm Report Monitor, see *Appendix E – Alarm Report Monitor (ARM2000).*)

What You Need to Do

Assess the installation site, prepare the site, install the LG*Cell* equipment, install and connectorize the cables, and mount the Hubs and RAUs. A typical installation consists of three components:

- Site Planning   See *Section 3, LGCell Site Planning and Design*
- Cable Installation   See *Section 3, LGCell Site Planning and Design*
- LG*Cell* Installation   See *Section 4, LGCell Installation*

2 LG*Cell* Equipment

This section describes the LGC*ell* equipment and explains how the system operates and contains LGC*ell* system specifications.

For details about cables and connectors, refer to *Appendix A – Cables, Connectors, and Accessories*.

LGC*ell* has no user-serviceable parts. Faulty or failed units may be repaired or replaced through LGC Wireless. In the U.S., please contact us at 1-800-530-9960. International customers, please contact us at +1-408-487-2400.

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LGCell Equipment

Standard Equipment

The LGC*ell* standard equipment supports 800 MHz AMPS/TDMA/CDMA/iDEN, 900 MHz GSM, 1800 MHz DCS, 1800 MHz Korean PCS, 1900 MHz TDMA/ CDMA/GSM, and Dual Band 900 GSM/1800 DCS installations.

LGC*ell* has three modular components:

- Main Hub – 19" rack-mountable

- Expansion Hub – 19" rack-mountable

- Remote Antenna Units (RAUs) – Wall or ceiling mountable

LGC*ell* is shipped with the following items:

- Four rack-mount screws per hub

- Four screws for each RAU

- *LG*Cell *Installation and Reference Manual*

For cable and accessory information, see *Appendix A – Cables, Connectors, and Accessories.*

Main Hub
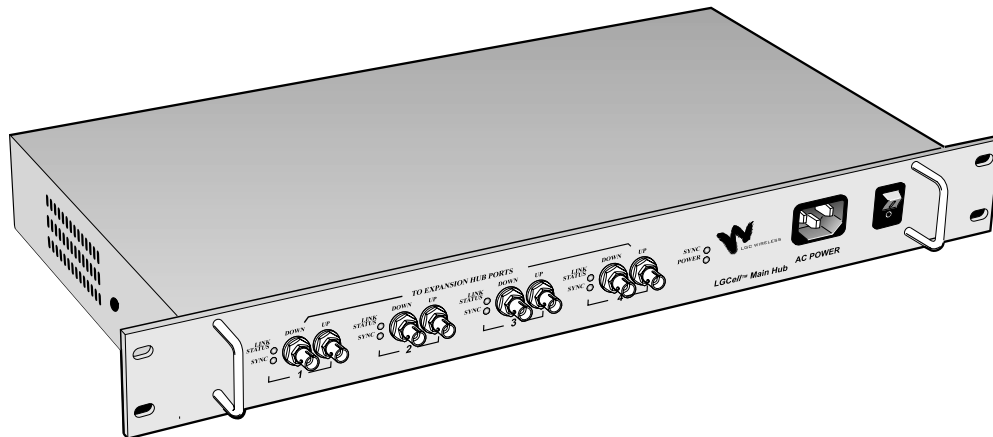
The Main Hub is the LGC*ell*'s central distribution point. It receives downlink cellular or PCS signals from an MBS or a roof-mounted antenna and redistributes them to multiple Expansion Hubs in low-frequency signal format (<200MHz), which can be passed over the MMF and CAT 5 cabling.

The Main Hub also receives signals from the Expansion Hubs and reconverts them back to the cellular or PCS band for transmission on the uplink channel (mobile) to the macrocellular base station (BTS) or microcellular base station (MBS).
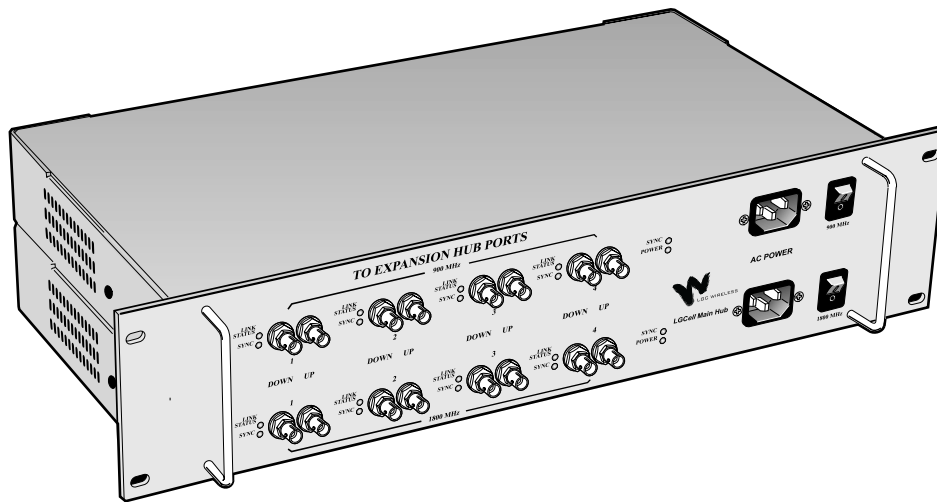
The Dual Band 900/1800 Main Hub is shown below.

Main Hub Features

- Mounts in a standard 19" equipment rack, width 17.25" (438 mm)

- Height is 1.7" (44.5 mm). The Dual Band Main Hub is 3.5" (88.9 mm) high.

- Operates with worldwide AC power, 100-240 VAC at 1.6 A and 50/60 Hz

- Connects up to four Expansion Hubs and 16 RAUs per Main Hub. The Dual Band Main Hub connects up to four Expansion Hubs and 16 RAUs for the 900 system and an equal number for the 1800 system.

- Connect multiple Main Hubs to increase number of RAUs. See "Connecting Multiple LGCell Systems" on page 3 in *Section 5, Connectivity*.

- Connects to a roof-mounted antenna, repeater, or duplexed MBS via one coaxial cable using an N-type, female, duplexed, bi-directional RF connector

- Connects to MBS via two coaxial cables using two N-type female, simplex RF connectors

- Connects to Expansion Hubs via MMF fiber cable (up to 1 kilometer)

- Distributes cellular or PCS signals to the Expansion Hubs via standard MMF transmit and receive pairs

- Has easily accessible connectors

- Displays system status via front panel LEDs
- Provides contact closure of major alarms and error latches through a D-sub 9-pin connector

Main Hub Front Panel
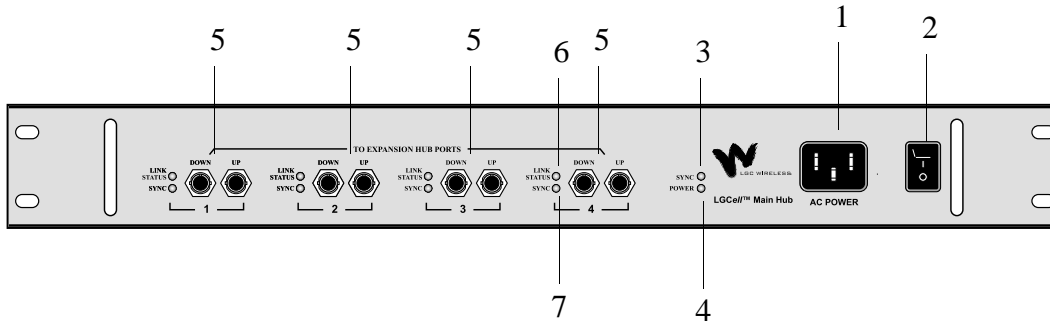
Front Panel Description

1 AC power cord connector

2 Power On/Off switch

3 One LED for sync status (labeled **SYNC**)

4 One LED for power (labeled **POWER**)

5 Four Ports (labeled **1**, **2**, **3**, **4**)
  •One standard female ST-connector for MMF downlink (labeled **DOWN**)

  •One standard female ST-connector for MMF uplink (labeled **UP**)

6 One LED for port RF link status (labeled **LINK STATUS**)

7 One LED for port sync status (labeled **SYNC**)

The Dual Band Main Hub Front Panel is shown below. The connectors are the same as those explained for the single band system.
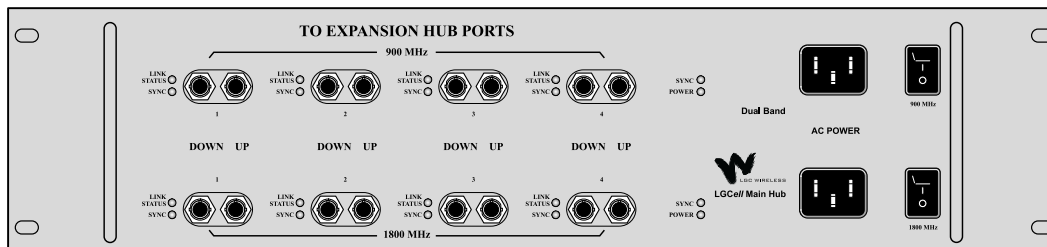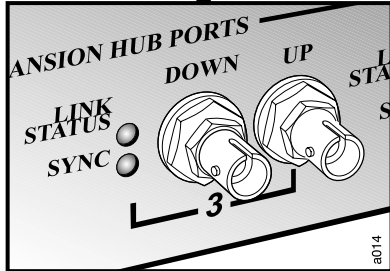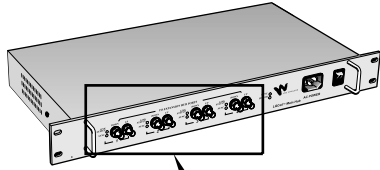
Standard MMF Uplink and Downlink Ports

The Main Hub transmits and receives RF signals to and from the Expansion Hubs using up to 1 kilometer of industry-standard 62.5μm/125μm MMF cable (up to 1.5 dB optical loss, approximately 1 kilometer without jumpers).

•**Uplink/Input** (labeled **UP**)

   This signal is the combination of all uplink signals received by the Expansion Hubs connected to the system.

•**Downlink/Output** (labeled **DOWN**)

   The downlink is a composite signal coming from the duplexed N-type connector or from the downlink simplex connector on the Main Hub back panel. The downlink signal is re-radiated at all RAUs.

Main Hub LEDs

LED	Color	Indication
HUB LEDs		
POWER	Green	On/Off Fault
SYNC	Green	On/Off Fault
PORT LEDs		
SYNC	Green Red	Operational Fault
LINK STATUS	Green Red	Operational Fault

Main Hub Back Panel
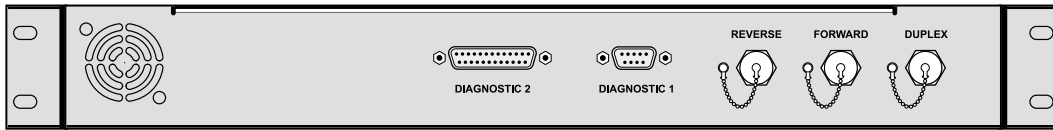
a015

Back Panel Description

- Three N-type, Female Connectors with dust caps

  - One Duplexed (labeled **DUPLEX**)

  - One Uplink (labeled **REVERSE**)

  - One Downlink (labeled **FORWARD**)

- One D-Sub 9-pin Connector (labeled **DIAGNOSTIC 1**)

- One D-sub 25-pin Connector (labeled **DIAGNOSTIC 2**)

The Dual Band Main Hub Back Panel is shown below. The connectors are the same as shown for the single band LG*Cell* Main Hub.

Rear View of Main Hub

N-Type (Female) Connectors

a016
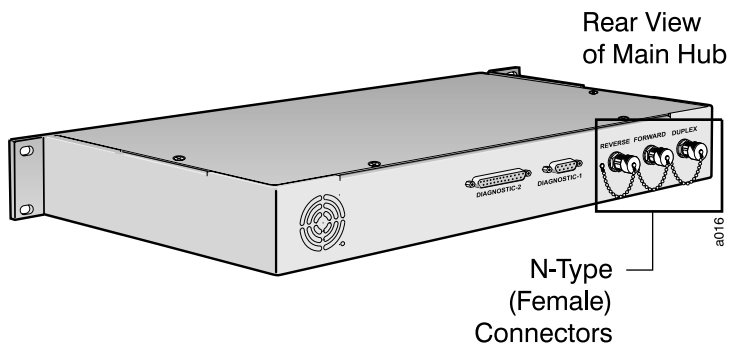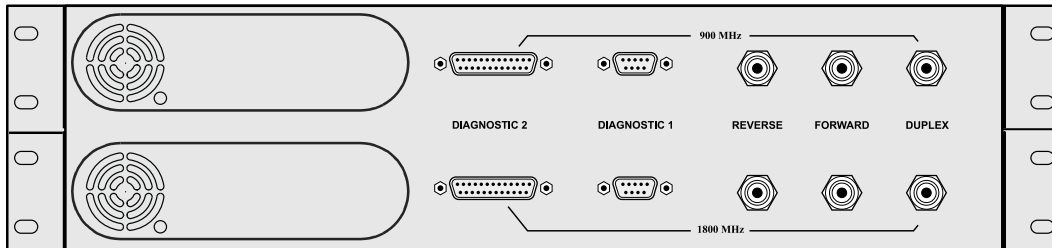
N-Type Female Connectors

The N-type, female connectors connect the coaxial cable from the roof-mounted antenna, repeater, or MBS to the Main Hub for RF connection. These cable connectors are operational in the cellular and PCS frequency bands.

See *Maximum Input RF Power per Carrier vs. Number of Carriers,* on page 17 in this section for the maximum uplink and downlink power.

There are three N-type female connectors:

Duplexed: Output and Input (bi-directional)

Uplink: Simplex Output (unidirectional)

Downlink: Simplex Input (unidirectional)

- **Duplexed (labeled DUPLEX)**

  The **DUPLEX** connector is for a duplexed
  connection. This connector provides both
  downlink and uplink signals to and from the
  roof-mounted antenna, repeater, or MBS to the
  Main Hub. This duplex port provides a 30 or 40
  dB gain on the duplex part. See "LGCell
  System Gain" on page 17.
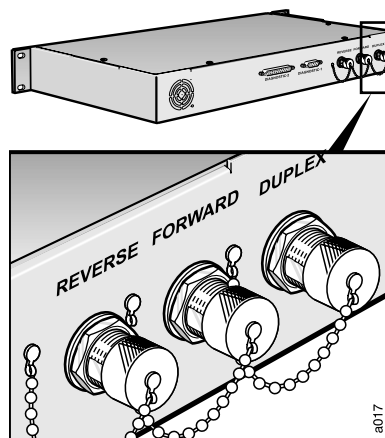
- **Uplink (labeled REVERSE) and
  Downlink (labeled FORWARD)**

  The uplink and downlink connectors are for a
  simplex connection. The **FORWARD** connector
  receives RF signals and the **REVERSE** connector
  transmits RF signals to and from the roof-
  mounted antenna, repeater, or MBS.
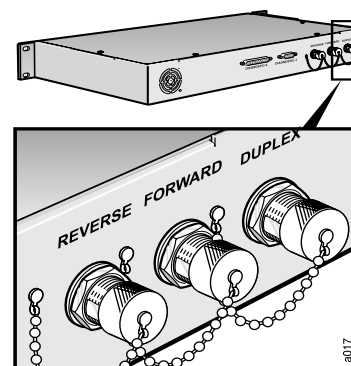
DO NOT exceed the maximum input power into the Main Hub. See
Maximum Input RF Power per Carrier vs. Number of Carriers, on page
17 in this section.

D-Sub 9-Pin Connector

The D-Sub 9-pin connector (labeled **DIAGNOSTIC 1**) provides contact closure for major and latch system alarm monitoring. The following table lists the function of each pin on the D-sub 9-pin connector.
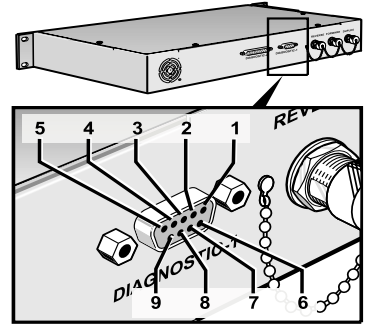
Pin	Function
1	+10 V (fused)
2	Not connected
3	Not connected
4	Error Latch (positive connection)
5	Error Latch (negative connection)
6	DC Ground
7	Major Error (positive connection)
8	Error Reset
9	Major Error (negative connection)

Alarms

LGC*ell* provides full Operations Alarm Maintenance and Provisioning (OAM&P). The Main Hub senses then latches major alarms. An error latch provides historical information for troubleshooting.

The major alarms and error latches are monitored with contact closures. Alarms can be sent to remote locations (see *Section 5, Connectivity* and *Section 6, Troubleshooting*). For details about alarm monitoring, see *Appendix E – Alarm Report Monitor (ARM2000)*.

The two error connections, Major Error and Error Latch, are relay connections. They are either open or short circuit (see the following table).

Operation	Major Error	Error Latch
Proper Operation	Short Circuit	Short Circuit
Error	Open Circuit	Open Circuit
Proper Operation but had error and system latched; alarm was not reset	Short Circuit	Open Circuit

When you use these error pin connections, determine the error status by sending a current of no more than 40 mA through the positive connection and returning it through the negative connection. An error is indicated if current ceases to flow through the error connection.

Expansion Hub

Antenna Ports

Main Hub Port

1 2 3 4
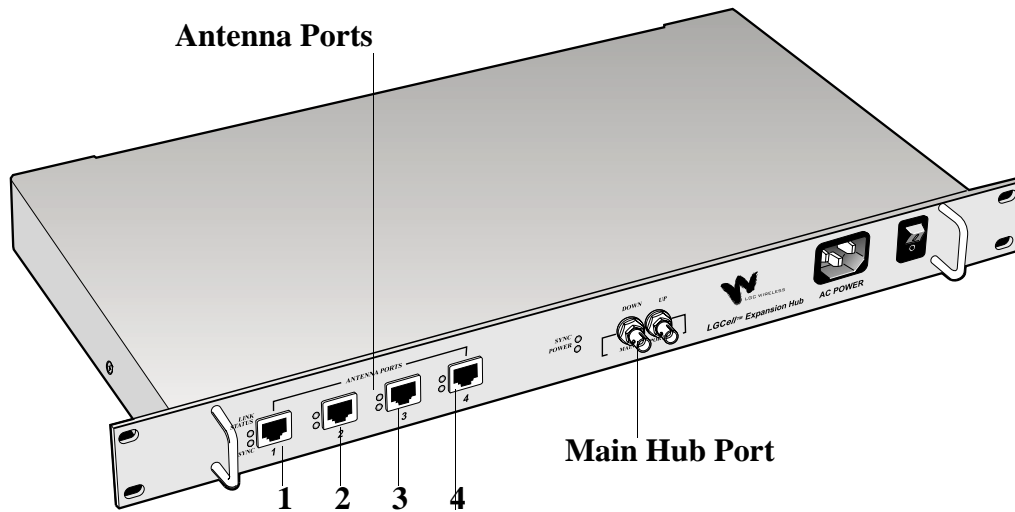
The Expansion Hub is LG*Cell*'s intermediate distribution point.

It transmits and receives low frequency signal (<200MHz) to and from the Main Hub, and to and from the RAUs. Utilizing LGC Wireless' proprietary technology, both the MMF and the UTP/STP cables can transmit signals in the cellular or PCS frequency bands.

The Dual Band 900/1800 Expansion Hub is shown below:

Expansion Hub Features

- Mounts in a standard 19" equipment rack, with 17.25" (438 mm)

- Height is 1.7" (44.5 mm). The Dual Band Expansion Hub is 3.5" (88.9 mm) high.

- Operates with worldwide AC power, 100-240 VAC at 1.6 A and 50/60 Hz

- Connects up to four RAUs. The Dual Band Expansion Hub connects up to four RAUs for the 900 system and up to four RAUs for the 1800 system.

- Connects to the Main Hub with MMF transmit/receive cable (up to 1.5 dB optical loss, approximately 1 kilometer without jumpers)

- Connects up to four RAUs via four RJ-45 connectors that feed RAUs directly through a UTP/STP cable

- Provides DC power to RAUs through the UTP/STP cable

- Has easily accessible connectors

- Displays system operation via front panel LEDs

- Communicates with Main Hub for system alarm status

Expansion Hub Front Panel

(Labeled **1**, **2**, **3**, and **4**)
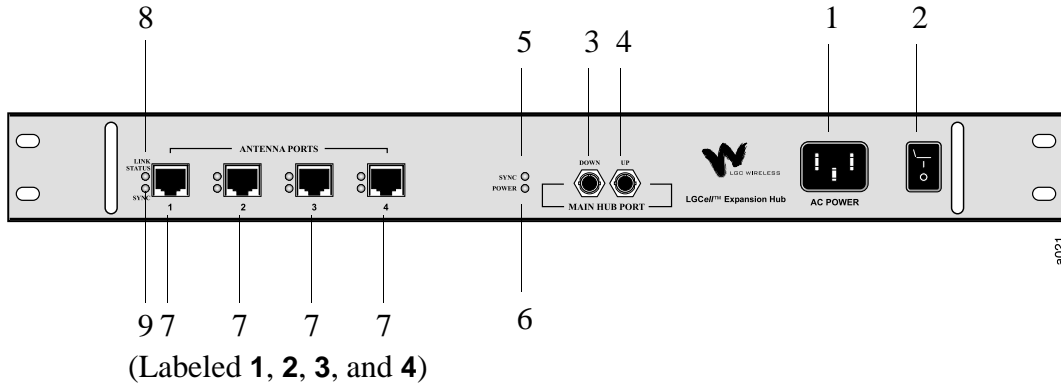
Expansion Hub Description

1   AC power cord connector
2   Power On/Off switch
3   In Fiber Port (labeled **MAIN HUB**), one standard ST connector for MMF downlink (labeled **DOWN**)
4   In Fiber Port (labeled **MAIN HUB**), one standard ST connector for MMF uplink (labeled **UP**)
5   One LED for port sync status (labeled **SYNC**)
6   One LED for power (labeled **POWER**)
7   Four standard UTP/STP CAT 5 Cable RJ-45 female connectors (labeled **ANTENNA PORTS 1**, **2**, **3**, and **4**)

8   One LED to monitor RF link status (labeled **LINK STATUS**)

9   One LED to monitor sync status (labeled **SYNC**)

The Dual Band Expansion Hub Front Panel is shown below. The connectors are the same as those explained for the single band system.
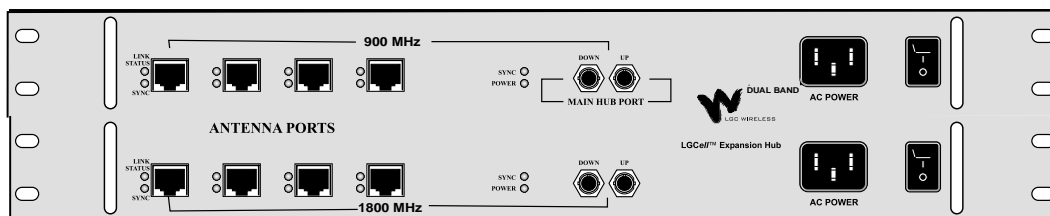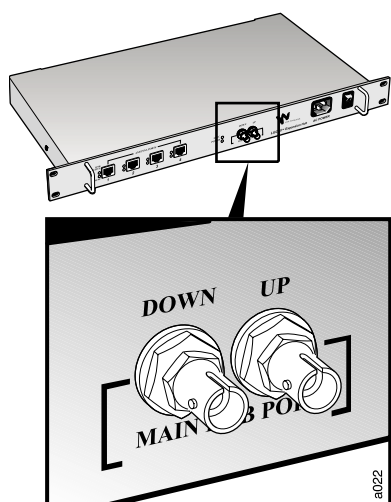
Standard MMF Uplink and Downlink Port

The Expansion Hub transmits and receives cellular or PCS signals to and from the Main Hub using up to 1 kilometer of industry-standard 62.5μm/125 μm MMF cable found in most buildings.

•Uplink/Output (labeled **UP**)

The uplink is the combination of all uplink signals received by the RAUs. The signals are fed into the Expansion Hub via the UTP/STP cables. The Expansion Hub then transmits the combination of all signals to the Main Hub via the MMF cable.

•Downlink/Input (labeled **DOWN**)

The Expansion Hub receives downlink signals from the Main Hub via the other MMF port. The downlink signals are subsequently re-radiated at all RAUs via the UTP/STP cable.

UTP/STP CAT 5 Cable Connectors

Delivers electrical power to the RAUs. Also transmits downlink signals and receives uplink signals to and from the RAUs.

Expansion Hub LEDs

LED	Color	Indication
HUB LEDs		
POWER	Green	On/Off Fault
SYNC	Green	On/Off Fault
PORT LEDs		
SYNC	Green Red	Operational Fault
LINK STATUS	Green Red	Operational Fault
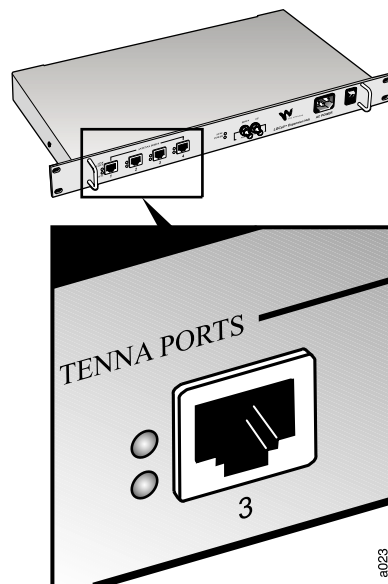
Remote Antenna Unit (RAU)

RAU Description

- One female SMA connector
- One Standard CAT 5 UTP/STP RJ-45 female receptacle
- Two LEDs
    - One for antenna power
    - One for antenna sync indication
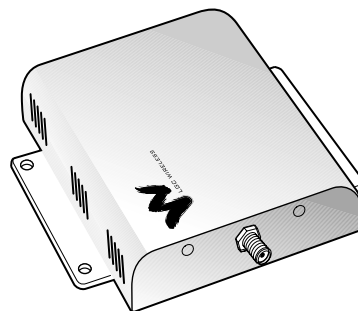
The Dual Band 900/1800 RAU is shown here. The Dual Band RAU has the same connectors as the single band RAU. It has one set of connectors for the 900 RAU and one set for the 1800 RAU.
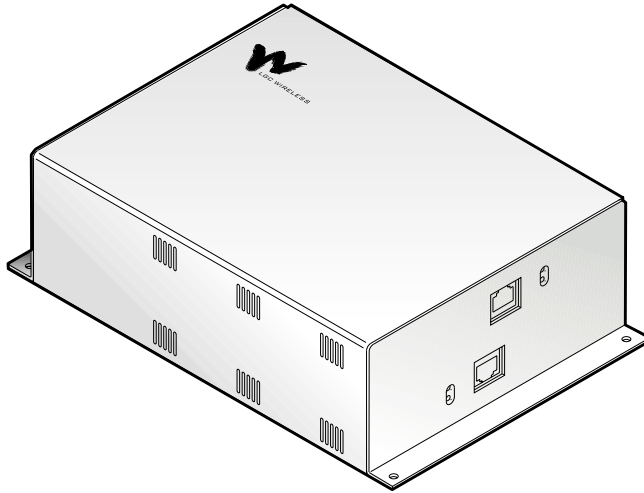
RAUs are active antennas that connect directly to an Expansion Hub over standard CAT 5 (or better) UTP/STP cable. The cable also delivers electrical power to the antenna.

RAUs receive uplink cellular or PCS signals and re-transmits them to an Expansion Hub in a low frequency signal format (<200MHz).

They also receive signals from the Expansion Hub, and re-convert the signals back to the cellular or PCS band for transmission on the downlink.

RAU Features

- Transmits to Expansion Hubs via an RJ-45 connector using UTP/STP cable

- Uses an SMA connector for standard in-building antennas

- Has easily accessible connectors

- Displays system operation via LEDs

- Dimensions: 5.7" x 5.5" x 1.2" (145 mm x 140 mm x 30 mm). The dimensions for the Dual Band RAU are 8" x 6.2" x 2.7" (1626 mm x 157 mm x 69 mm).

- Connects to Expansion Hub via one RJ-45 connector that feeds RAUs directly through a UTP/STP cable (up to 60 meters)

For system performance for cable lengths greater than 60 meters, see "LGCell System Gain vs. UTP/STP Cable Length (800 MHz, iDEN, 900 MHz)" on page 6 and "LGCell System Gain vs. UTP/STP Cable Length for 1800 MHz or 1900 MHz (Horizontal run, measured with 1 km of Multi-Mode Fiber)" on page 7 in *Appendix A – Cables, Connectors, and Accessories*.

RAU Connectors
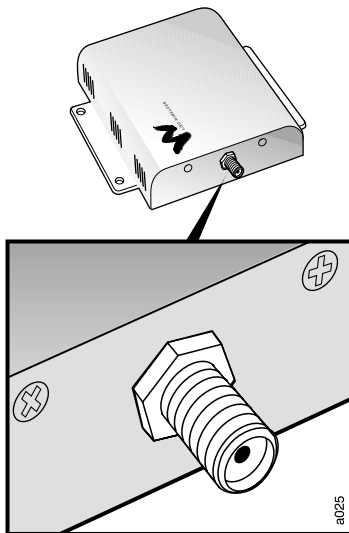
SMA Connector

The SMA connector on the RAU is a duplexed RF input/output port that connects to standard in-building antennas.

•Uplink (Input)

> The uplink cellular or PCS channels are received from the mobile phone by the in-building antenna. For the maximum downlink composite radiated power at the RAU, see the table on page 17 in this chapter.

•Downlink (Output)

> The downlink channels are transmitted (radiated) by the standard in-building antenna. For the maximum downlink composite radiated power at the RAU, see the table on page 17 in this chapter.

Standard CAT 5 UTP/STP RJ-45 Jack

Delivers electrical power to the antenna. Also transmits and receives uplink and downlink signals to the Expansion Hub.
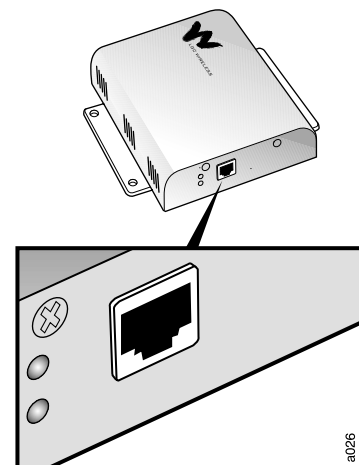
RAU LEDs

LED	Color	Indication
POWER	Green	On
SYNC	Red	Fault

If the antenna **SYNC** LED lights red, RF power in the antenna is automatically shut down. The antenna RF power is reset when the **SYNC** LED goes off.

RAU Optional Antennas

The following illustration shows optional antennas that can plug into the SMA connector. For recommended antennas, refer to the accessory section in the LG*Cell* Price List or contact your account manager.
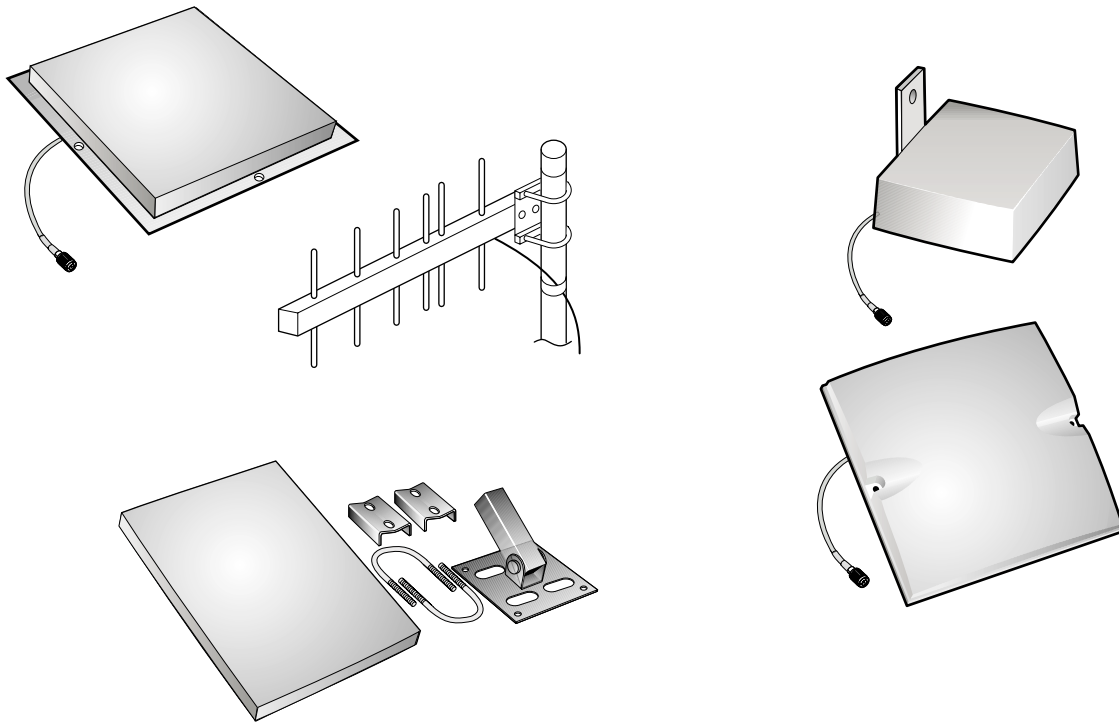
LGC*ell* System Specifications

The following tables give system specifications for LGC*ell*.

- System gain, maximum input/output RF Power

- Maximum Input Power per Carrier vs. Number of Carriers

LGC*ell* System Gain

This table is a summary of the system gain for different frequencies and formats.

LGC*ell* Frequency/Format	System Gain	
	Duplex	Simplex
800 MHz AMPS, TDMA	30	0
800 MHz CDMA	30	0
800 MHz iDEN	0	0
900 MHz GSM	0	0
1800 MHz CDMA	0	0
DCS 1800 GSM	0	0
1900 MHz TDMA	40	0
1900 MHz CDMA	40	0
1900 MHz GSM	40	0

Maximum Input RF Power per Carrier vs. Number of Carriers

When you connect a Main Hub to an MBS that supports several RF carriers, the RF power per carrier must be cut back so as not to exceed the total composite radiated power into the Main Hub **DUPLEX** or **FORWARD** connector. The following table shows the maximum power per carrier and maximum composite power for different frequencies, formats, and numbers of carriers.

800 CDMA		
Number of Carriers	Maximum Power per Carrier	Maximum Composite Power
1	10.0	10.0
2	7.0	10.0
3	5.2	10.0
4	3.0	9.0

1800 Korean CDMA		
Number of Carriers	Maximum Power per Carrier	Maximum Composite Power
1	9.0	9.0
2	6.0	9.0
3	4.2	9.0
4	2.0	8.0

1900 TDMA		
Number of Carriers	Maximum Power per Carrier	Maximum Composite Power
1	10.0	10.0
2	7.0	10.0
3	5.2	10.0
4	3.0	9.0

800 AMPS		
Number of Carriers	Maximum Power per Carrier	Maximum Composite Power
1	20.0	20.0
2	15.5	18.5
3	12.8	17.6
4	11.0	17.0
5	9.5	16.5
6	8.3	16.1
7	7.3	15.8
8	6.5	15.5
9	5.7	15.2
10	5.0	15.0
11	4.4	14.8
12	3.8	14.6
13	3.3	14.4
14	2.8	14.3
15	2.4	14.1
16	1.9	14.0

800 TDMA		
Number of Carriers	Maximum Power per Carrier	Maximum Composite Power
1	17.0	17.0
2	12.5	15.5
3	9.8	14.6
4	8.0	14.0
5	6.5	13.5
6	5.3	13.1
7	4.3	12.8
8	3.5	12.5
9	2.7	12.2
10	2.0	12.0
11	1.4	11.8
12	0.8	11.6
13	0.3	11.4
14	-0.2	11.3
15	-0.6	11.1
16	-1.1	11.0

800 GSM		
Number of Carriers	Maximum Power per Carrier	Maximum Composite Power
1	20.0	20.0
2	8.0	11.0
3	6.0	10.8
4	4.7	10.7
5	3.8	10.8
6	3.0	10.8
7	2.3	10.8
8	2.0	11.0
9	1.5	11.0
10	1.2	11.2
11	0.8	11.2
12	0.5	11.3
13	0.3	11.4
14	0.0	11.5
15	-0.1	11.7
16	-0.3	11.7

1800 DCS/GSM			1900 AMPS			1900 TDMA		
Number of Carriers	Maximum Power per Carrier	Maximum Composite Power	Number of Carriers	Maximum Power per Carrier	Maximum Composite Power	Number of Carriers	Maximum Power per Carrier	Maximum Composite Power
1	18.0	18.0	1	20.0	20.0	1	17.0	17.0
2	6.0	9.0	2	13.5	16.5	2	12.5	15.5
3	4.0	8.8	3	11.5	16.3	3	9.8	14.6
4	2.7	8.7	4	10.3	16.3	4	8.0	14.0
5	1.8	8.8	5	9.3	16.3	5	6.5	13.5
6	1.0	8.8	6	8.3	16.1	6	5.3	13.1
7	0.3	8.8	7	7.3	15.8	7	4.3	12.8
8	0.0	9.0	8	6.5	15.5	8	3.5	12.5
9	-0.4	9.1	9	5.7	15.2	9	2.7	12.2
10	-0.8	9.2	10	5.0	15.0	10	2.0	12.0
11	-1.1	9.3	11	4.4	14.8	11	1.4	11.8
12	-1.4	9.4	12	3.8	14.6	12	0.8	11.6
13	-1.7	9.4	13	3.3	14.4	13	0.3	11.4
14	-1.9	9.6	14	2.8	14.3	14	-0.2	11.3
15	-2.1	9.7	15	2.4	14.1	15	-0.6	11.1
16	-2.3	9.7	16	1.9	14.0	16	-1.1	11.0

1900 GSM		
Number of Carriers	Maximum Power per Carrier	Maximum Composite Power
1	20.0	20.0
2	8.0	11.0
3	6.0	10.8
4	4.7	10.7
5	3.8	10.8
6	3.0	10.8
7	2.3	10.8
8	2.0	11.0
9	1.5	11.0
10	1.2	11.2
11	0.8	11.2
12	0.5	11.3
13	0.3	11.4
14	0.0	11.5
15	-0.1	11.7
16	-0.3	11.7

Band Selective Option

LGC*ell* 800 MHz, 900 MHz, 1800 MHz, and 1900 MHz

The LGC*ell* 800/900 MHz system has fixed bands of operation. The LGC*ell* 1800/1900 MHZ system has a fixed bandwidth filter in each system that is centered over the desired band of operation. The desired band of operation is an ordered item either by band (A, B, D, E, F) or by the center uplink and downlink frequency.

The following table shows the bandwidths for each type of system.

System	Fixed Filter Bandwidth	Uplink Center Frequency	Downlink Center Frequency
DAS 800 MHz - AMPS, TDMA, CDMA	25 MHz	836.5 MHz	881.5 MHz
DAS 800 MHz - iDEN	18 MHz	815 MHz	860 MHz
DAS 900 GSM	25 MHz	947.5 MHz	902.5 MHz
DAS 1800 KOREAN CDMA	30 Mhz	1765 MHz	1855 MHz
DAS 1800 DCS (GSM)	30 MHz	1725 MHz[1] to 1770 MHz	1820 MHz[1] to 1865 MHz
DAS 1900 MHz - CDMA, TDMA, GSM	15 MHz	1857.5 MHz[2] to 1892.5 MHz	1937.5 MHz[2] to 1972.5 MHz

For example, the **A** band for 1900 MHz PCS has the fixed 15 MHz filter centered at 1937.5 MHz for the downlink and 1857.5 for the uplink.

[1] 30 MHz pass filter can be positioned along the 75 MHz DCS 1800 band. Order product with uplink and downlink frequency at 1.25 MHz spacing. For example an uplink center frequency of 1737.5 MHz will provide a 30 MHz band between 1722.5 MHz and 1752.5 MHz and a downlink center frequency of 1832.5 MHz will provide a 30 MHz band between 1817.5 MHz and 1847.5 MHz.

[2] Similar to above, the 1900 PCS 15 MHz filter can be positioned along the 60 MHz band.

The LG*Cell* covers a 30 MHz band in frequency range of 1710 MHz to 1785 MHz on the uplink and 1805 MHz to 1880 MHz on the downlink. The operator can choose where to place the 30 MHz band of operation by choosing the corresponding center frequencies as shown in the following table.

Band Center Frequency of the DCS 1800 MHz LG*Cell*
The filter band is 30 MHz wide (or 15 MHz on each side of the center).

Uplink Freq	Downlink Freq	Uplink Freq	Downlink Freq
1725.00	1820.00	1748.75	1843.75
1726.25	1821.25	1750.00	1845.00
1727.50	1822.50	1751.25	1846.25
1728.75	1823.75	1752.50	1847.50
1730.00	1825.00	1753.75	1848.75
1731.25	1826.25	1755.00	1850.00
1732.50	1827.50	1756.25	1851.25
1733.75	1828.75	1757.50	1852.50
1735.00	1830.00	1758.75	1853.75
1736.25	1831.25	1760.00	1855.00
1737.50	1832.50	1761.25	1856.25
1738.75	1833.75	1762.50	1857.50
1740.00	1835.00	1763.75	1858.75
1741.25	1836.25	1765.00	1860.00
1742.50	1837.50	1766.25	1861.25
1743.75	1838.75	1767.50	1862.50
1745.00	1840.00	1768.75	1863.75
1746.25	1841.25	1770.00	1865.00
1747.50	1842.50		

The following table shows settings for the 1900 MHz system.

Settings for Selecting Band Center Frequency of the 1900 MHz LG*Cell* System

Band	Uplink Frequency	Downlink Frequency
A	1857.50	1937.50 MHz
D	1867.50	1947.50 MHz
B	1877.50	1957.50 MHz
E	1887.50	1967.50 MHz
F	1892.50	1972.50 MHz

3 LGC*ell* Site Planning and Design

This section provides information to assist in planning and designing an LG*Cell* system and preparing a site for the LGC*ell* installation. Proper project management is instrumental in providing a timely and accurate deployment.

The first step in planning an LG*Cell* system is to estimate the amount of radio frequency (RF) coverage you need for your building or coverage area. Initial estimates can be developed using floor plans and the models that follow. Eventually you need to go on-site to evaluate the facility's readiness for installation and possibly perform RF measurements in order to guarantee performance. The LGC Wireless Site Survey Questionnaire is included for your reference.

Contents

LGCell Site Planning and Design

LGC WIRELESS

Project Management

Installing the LGC*ell* system is easy after all of the pre-installation requirements are met. It is beneficial to have one person manage and coordinate all aspects of the planning, design, and installation. Managing the process should avoid unnecessary surprises.

The project manager is the person responsible for assigning tasks and ensuring scheduled work is performed on time. This includes collecting all information necessary for a complete site assessment, getting cost estimates and purchase order (PO) approval, scheduling any cabling work, scheduling the LGC*ell* installation and commissioning, and providing final as-built documentation.

The project manager also acts as the coordinator between the following people:

    Cellular or PCS carrier
    RF engineer
    Site acquisition person
    MBS vendor
    MBS installer
    Cabling contractor(s)
    End user

If you do not have a designated project manager, please contact LGC Wireless. We can provide you with an estimate of what it would cost to have LGC Wireless manage your project. Please call us at 1-800-530-9960 (in the U.S.). International customers, please call us at +1-408-487-2400.

Project Management Estimated Timeline

Description	Details	Time Interval
Detailed site walk-through/RF survey	Prepare installation information, including RF plan, floor plan, equipment order form, and final design.	2 weeks
Order LGC*ell* equipment	Get all standard parts and accessories required.	8 weeks
Select cabling contractor	Complete installation statement of work and provide floor plan with equipment locations, list of cabling runs, and other materials and connections. Get cabling quotation after walk-through.	2 weeks
Order all other equipment	Get equipment from all vendors, including cables, connectors, MBS, surge protectors, and so on. Monitor order progress and shipment.	4 weeks
Install cable	Monitor installation.	1-5 days
Install LGC*ell*	Review installation checklist and prepare all materials.	1-3 days
Test installation and RF coverage	Be sure there are no blank areas.	1 hour per RAU
Generate as-built document	Prepare site plan diagram and coverage performance.	1-5 days

RF Coverage Estimate for a Site

To provide adequate RF coverage within a facility, you need a median signal level strong enough for good voice communications.

As a guideline, you can refer to the following tables for general coverage areas, based on a design goal of 0 dBm output power per carrier, -85 dBm received signal strength (independent of communications protocol), 5 dB fade margin and 3 dBi antenna gain.

Antenna Coverage for 800/900 MHz Frequency Applications (0 dBm per carrier, 5 dB fade margin, -85 dBm design goal and 3 dBi antenna gain)

Facility	PLS	Coverage per Antenna (Square Feet)
Manufacturing	27.3	30,000
Hospital	28.8	15,000
Airport	27.3	30,000
Retail	27.7	25,000
Warehouse	27.3	30,000
Parking Garage	26.8	40,000

Antenna Coverage for 1800/1900 MHz Frequency Applications

Facility	PLS	Coverage per Antenna (Square Feet)
Manufacturing	24.9	25,000
Hospital	26.5	10,000
Airport	24.9	25,000
Retail	25.2	20,000
Warehouse	24.9	25,000
Parking Garage	24.3	35,000

Office Antenna Coverage for 800/900 MHz Frequency Applications

Facility	PLS	Coverage per Antenna (Square Feet)
Open – 80% cubicles/20% offices	27.7	25,000
80% - 50% cubicles/50% offices	28.2	20,000
10% - 20% cubicles/80% offices	28.8	15,000

Office Antenna Coverage for 1800/1900 MHz Frequency Applications

Facility	PLS	Coverage per Antenna (Square Feet)
Open – 80% cubicles/20% offices	25.2	20,000
80% - 50% cubicles/50% offices	25.7	15,000
10% - 20% cubicles/80% offices	26.5	10,000

The preceding tables show estimated clutter-defined path loss slope (PLS) for different frequencies at various kinds of sites. If you change the design goal or other parameters, these numbers will change based on the PLS.

If the design parameters (output power per carrier, design goal, antenna gain, and fade margin) differ from those stated above, you can use the PLS value shown in the preceding tables in the following formula to estimate the area of coverage per antenna:

Path Loss Formulas

Path Loss (dB) = PLS * log $4\pi fD / c$

> Note: Path Loss Slope = PLS dB/decade for free space loss

> D is the distance in meters
> f is the frequency in MHz
> c is the speed of light

Path Loss=Power per Carrier + Antenna Gain - Fade Margin - Design Goal (dBm)

$$D = [10^{(\text{Path Loss / PLS})}] \times [c / (4\pi f)]$$

To convert feet to meters:

$$\text{Area} = (D \times 3.281)^2 \times \pi$$

The PLS is a general path loss number which takes into account free space loss and normal barriers to the RF signal. Severe obstructions such as metal, cement walls, or elevator shafts are best accounted for by a physical site survey.

As a reference the following table gives estimates of the signal loss for some RF barriers.

Average Signal Loss of Common Building Materials

Partition Type	Loss @ 815 MHz
Metal wall	26 dB
Aluminum siding	20 dB
Concrete block wall	13 dB
Foil insulation	4 dB
Concrete floor	15 dB
Sheetrock	1.4 dB

RF Measurements and Site Survey

Before designing an LG*Cell* system, one should go to the site and measure the loss characteristics of the building. To determine the amount of coverage per antenna, the best method is a test of RF propagation, which you can do on-site with a test transmitter and field strength meter.

While at the site, one can use the following Site Survey Questionnaire to document site specifics.

Site Survey Questionnaire

You can use the LGC Wireless Site Survey Questionnaire to help design your LG*Cell* system. A sample questionnaire follows. The following information is needed when you walk a site:

Site Survey Questionaire

585 EAST BROKAW ROAD | SAN JOSE, CA 95112 | TEL 408.487.2400 | FAX 408.487.2410

Project Name:		**Company Name:**	
Purchaser:		**Contact:**	
Address:		**Phone:**	
		E-Mail:	

End-User:		**End-User Contact:**	
Address:		**Phone:**	
		E-Mail:	

Type of System Enhancement:　　　　○ Coverage (BDA)　　○ Capacity (BTS)　　○ Wireless Office

If BTS, what Manufacturer & Model #: _____　　# of Carriers: _____

If BTS, what is the # of Subscribers: _____　BHCR: _____　Erlangs/Sub: _____

What is the desired downlink power at mobile (dBm):　☐ -75　☐ -80　☐ -85

Frequency(ies):　☐ 800　☐ 900　☐ 1800　☐ 1900

Protocol(s):　☐ AMPS　☐ iDEN　☐ GSM　☐ TDMA　☐ CDMA
　　　　　　　☐ DCS

Are Floor Plans Available (Including Map Scale):　☐ YES　☐ NO

Is Coverage Required Out Doors:　☐ YES　☐ NO

If Floor Plans are not available, how many Buildings are to be Covered: _____

How Many Floors per Building:　☐ 1　☐ 2　☐ 3　☐ 4　☐ 5

(Use the Add'l comments if needed)　☐ 6　☐ 7　☐ 8　☐ 9　☐ 10

Total Square Footage to Cover per Building:　1 =　2 =　3 =　4 =　5 =

(Use the Add'l comments if needed)　6 =　7 =　8 =　9 =　10 =

	Yes	No	Don't Know
Are Exposed Antennas Tolerated Inside:	☐	☐	☐
Are Exposed Antennas Tolerated Outside:	☐	☐	☐
Locations for Main & Expansion Hubs Available (closets):	☐	☐	☐
Are 19" Equipment Racks Available:	☐	☐	☐
Is AC Power available at the Main and Expansion Hubs:	☐	☐	☐
Are Multimode Fiber Optic Cables Already Available:	☐	☐	☐
Are CAT 5 UTP/STP Runs Already Available:	☐	☐	☐
Are LGC Wireless Services Required:	☐	☐	☐
If so, which Services:			
- Project Management:	☐	☐	☐
- Site Survey:	☐	☐	☐
- LGCell Equipment Install & Commissioning:	☐	☐	☐
- CAT5, MMF, Coax & Antenna Installation:	☐	☐	☐

Estimated Installation Start Date (Must Provide If Services are Needed): _____

Add'l Comments:
(Special install
requirements, covered
areas, contacts, etc)