UNItivity 5000
In-Building Wireless Solution

Installation and Configuration

Software Version 5

ZWSystemOverviewV2_22717

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Safety and Regulatory Information

Safety Information

The following safety warnings cautions are listed to prevent damage to equipment or property and prevent any risk of personal injury.

Warning: Dispose of all waste properly as per federal, state, and local waste disposal regulations. Improper disposal could result in personal injury and environmental impact.

Warning: If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used only in a normal condition (in which all means for protection is intact).

Warning: Before using the device, read through this entire manual. Attempting to use this device without a thorough understanding of its operation may result in injury.

Warning: To prevent electrical shock, do not remove the covers. Opening or tampering with sealed modules will invalidate the warranty.

Caution: No operator serviceable parts inside the sealed unit. If service is needed call Zinwave

Caution: The Hub is a "Class A" product (as defined in EN 55022). In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

Caution: For continued protection against risk of fire, replace the exterior accessible fuse only with same type and rating of fuse.

Caution: Position the power cord to avoid possible damage; do not overload wall outlets. Use only the supplied power cord.

Caution: Do not place this product on or near a direct heat source, and avoid placing objects on the terminal.

Caution: Use only a damp cloth for cleaning. Do not use liquid or aerosol cleaners. Disconnect the power before cleaning.

Caution: Installation of UNItivity must be contracted to a suitably trained and competent professional installer.

Caution: Do not over-tighten the hardware.

Caution: UNItivity is designed to operate in conditions conformant with Pollution Degree 2 as defined in IEC 60950 (the normal environmental class for offices).

Caution: The installation of sub-assemblies into the main units of UNItivity shall only be undertaken if precautions required by IEC/TS 61340-5-1 have been taken.

Electricity Supply

Warning: Insulation on electrical wiring can deteriorate with age. Check for brittle or deteriorated insulation on power cord and all other electrical wiring.

Warning: CLASS I PLUGGABLE EQUIPMENT TYPE A as defined in IEC 60950. This equipment is intended for connection to other equipment or a network, relies on connection to protective earth and must be connected to an earthed mains socket-outlet.

Country specific warnings:

Finland "Laite on liitettŠvä suojamaadoituskoskettimilla varustettuun pistorasiaan"
Norway "Apparatet må tilkoples jordet stikkontakt"
Sweden "Apparaten skall anslutas till jordat uttag

Warning: Do not excessively bend, twist, or tie the power cable. Do not place any heavy items on the power cable or place any sources of heat near to the equipment, as damage to the power cord could cause malfunction or fire.

Caution: The installation of electrical supplies in support of UNItivity products shall be in accordance with national and local regulations.

Caution: DOUBLE POLE/NEUTRAL FUSING in Primary Hub.

Rack Mounting

Caution: Do not over-tighten the hardware.

Caution: Elevated Operating Ambient – Installing the equipment in an environment compatible with the maximum ambient temperature listed in the specifications.

Caution: Reduced Air Flow – Install the equipment with adequate of air flow required for safe operation.

Caution: Mechanical Loading – Do not load unevenly.

Caution: Circuit Overloading – Consider equipment nameplate ratings when connecting equipment to the supply circuit. Overloading of the circuits might have and effect on overcurrent protection and supply wiring.

Caution: Reliable Earthing – Maintain reliable earthing of rack-mounted equipment. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips).

Caution: Disconnect Device – The socket outlet shall be installed near the equipment, be easily accessible, and will act as the main point of disconnect for the Hubs.

Caution: Manual Handling – Installation should be carried out by two competent personnel as the equipment is heavy.

⚠ Caution: Hubs are heavy rack units which must be supported at the front when installed into a 19" rack. To avoid damage to the equipment do not support the whole weight using only 1 handle.

RF Exposure

⚠ Warning: This equipment complies with FCC radiation exposure limits set forth for an occupational/ controlled environment. The Remote Unit should be operated with a minimum distance of 20cm (8 in) between antenna and your body.

Installation

⚠ Caution: Incorrect installation, operation, and use of this equipment may cause failure to product and could cause accidents which may harm personnel.

⚠ Caution: Optical Module must ONLY be installed on the front panel of a Primary Hub or the unit will not function as expected.

⚠ Caution: Remote Units should be vertically-mounted to ensure optimum cooling effect and to achieve the maximum ambient operating specification. If the Remote Units mounted in the horizontal plane the maximum ambient operating temperature must be relaxed by 8°C (47 F)

Signal and Input Power

⚠ Warning: If the service module is connected directly to the output of a BTS or any RF input source, maximum power delivered to a service module must not exceed 15dBm. Use additional equipment to attenuate the power.

⚠ Caution: The input power to the Zinwave Remote Unit should not exceed -10dBm. Power levels greater than 0dBm will damage the unit

⚠ Caution: The total broadband composite output power of the Remote Unit is limited to +18 dBm in Europe and +20 dBm in the USA and Canada. The maximum allowed EIRP in the USA & Canada is +28 dBm which corresponds to an antenna gain of 8 dBi. Contact Zinwave for the maximum output power in other regions

⚠ Caution: Alarm Relays on the Hubs and Remote Unit are intended for low voltage/current signaling only. Maximum operating voltage 50V, maximum operating current 1A.

Fiber Considerations

⚠ Caution: Avoid dust ingress to fiber connectors by mounting the Remote Unit with the fiber connector facing downwards, or by leaving the dust-caps in place until the fiber is connected.

⚠ Caution: Connector types must match (i.e. SC/APC to SC/APC or SC/UPC to SC/UPC). Otherwise, there will be an air gap between the connector faces that will create high back reflection and high optical loss.

⚠ **Caution:** If there is a change in fiber core diameter, light must always travel from a smaller to a larger core diameter. Otherwise, there will be excessive optical loss. E.g. Singlemode can transmit into Multimode fiber but Multimode CANNOT transmit into Singlemode

⚠ **Caution:** Fiber handling procedures should be carefully observed so as not to damage or introduce dirt to fiber interfaces during installation

⚠ **Caution:** Observe safety precautions when working with fiber cables and devices.

Optical Safety Precautions
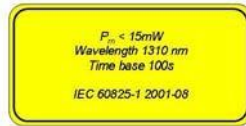
⚠ **Warning:** Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

⚠ **Caution:** Do not remove the fiber Port dust covers unless the port is in use. Do not stare directly into a fiber Port.

⚠ **Caution:** Cover any unconnected fiber ends with an approved cap.

⚠ **Caution:** Do not stare with unprotected eyes at any broken ends of the fiber.

⚠ **Caution:** Use only approved methods for cleaning optical fiber connectors.

⚠ **Caution:** Do not make any unauthorized modifications to this fiber optical system.

⚠ **Caution:** No warning signs are required as it is a Class 1 hazard.

⚠ **Caution:** Use Class 1 test equipment.

Software Installation

⚠ **Caution:** When new firmware is being installed it is very important not to break or interrupt the connection between source file and the Hub. Interrupting firmware installation may put the Hub into an irrecoverable state that requires factory reset.

⚠ **Caution:** While the system can be configured with poor optical links present, this may affect the system performance and such links should be examined and brought into specification in order to obtain optimum performance.

Symbols

This section identifies the symbols that are displayed on UNItivity devices. Labels or symbols may not appear on every device.

Symbol	Description
📖	Consult Manual
⚡	Electric shock hazard
c(UL)us LISTED	UL certified UL NRTL Listing
CE	The European CE mark
ISO 9001	ISO 9001certified
⟜	USB Port
⟗	Ethernet Port

Symbol	Description
	Electrostatic Discharge Sensitive
	This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment. (WEEE)

Regulatory Information

- EN 50174/50173 series: Information technology – Cabling installation
- ANSI/TIA/EIA-568 series North America Cabling
- ISO/IEC 11801 - International cabling
- IEC 60825-2: Safety of laser products – Part 2: Safety of optical fiber communication systems (OFCS)
- This equipment complies with 21CFR1040 - Performance Standards For Light-Emitting Products (FDA).
- EN 55032/CISPR32
- FCC Part 15 Class A
- European Radio Equipment Directive 2014/53/EU
- Electrical Safety IEC 60950-1
- Laser Safety EN 60825-1:2007
- ISO 9001
- UL-60950-1
- RoHS DIRECTIVE 2011/65/EU
- UL2043 compliance

In reference to UL2043 compliance, Remote Units are suitable for use in environmental air space in accordance with Section 300-22(c) of the National Electrical Code, and Sections 2-128, 12-010(3) and 12-100 of the Canadian Electrical Code, Part 1, CSA C22.1.

Note: The system contains a device which is classified as a "CLASS I LASER PRODUCT", with an internal Class 1 laser source (as defined in CBTR # DE3-500286 by TUV). The component within the unit is in compliance with "U.S. Code of Federal Regulations, 21 CFR 1040". See the Detailed Data Sheet for label placement.

UL NRTL listing

UNItivity has been tested and shown to meet UL and CSA requirements through testing carried out at a Nationally Recognized Testing Laboratory (NRTL). The UL certification Mark indicates national compliance to UL and CSA standards by virtue of accreditations obtained.

Product: Distributed Antenna System

Model: UNItivity, Hub and Remote Unit

UL Listing ID: E486578

FCC

FCC compliance and interference statements

Hub: UNItivity devices comply with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1) This device must accept any interference and

2) This device must accept any interference received including interference that may cause undesired operation

Changes or modifications not expressly approved by Zinwave Ltd. could void the user's authority to operate the equipment.

Remote Unit: This device complies with Part 22, Part 24, Part 27, Part 74 and Part 90 of the FCC rules. Changes or modifications not expressly approved by Zinwave Ltd. could void the user's authority to operate the equipment. For a list of services, please contact Zinwave**.**

- This device must only be used with antennas having a maximum gain of 8 dBi
- When operating on channel or channels under 47CFR part 90 as identified in the table below, this is a
  Class B booster as defined in 47CFR90.219.
  Class B boosters must be registered with the FCC prior to operation, which can be done at the FCC Part 90 Class B Signal Booster Registration & Discovery website:
  https://signalboosters.fcc.gov/signal-boosters/

⚠ **Warning:** This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90.219) online at www.fcc.gov/signal-boosters/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of $100,000 for each continuing violation.

- When operating on channel or channels under 47CFR parts 22, 24, 27 or 74 as identified in the table below, this is an Industrial Booster as per 47CFR part 20.

⚠ **Warning:** This is NOT a CONSUMER device. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of $100,000 for each continuing violation.

UPO305-0007

Remote Unit with FCC ID: FCC ID UPO302-XX107 only supports services in the following bands of operation:

Rule Part	Band	Downlink Frequency Range (MHz)	Service	Modulation
90	VHF Public Safety	150.8 – 156.2475 157.1875 – 161.575 161.775 – 161.9625 162.0125 – 173.4	P25	C4FM (QPSK)
			FM	FM ±2.5kHz dev'n
	UHF Public Safety	406.1 - 420 421 - 430	P25	C4FM (QPSK)
			FM	FM ±2.5kHz dev'n
			FM	FM ±5.0kHz dev'n
		456.0 – 462.5375 462.7375 - 467.5375 467.7375 - 512.0	P25	C4FM (QPSK)
			FM	FM ±2.5kHz dev'n
			FM	FM ±5.0kHz dev'n
74	UHF PMSE	470 – 608 614 – 679.9	FM	FM ±75kHz dev'n
90	700MHz Public Safety	769 – 775	P25	C4FM (QPSK)
			OpenSky	4-level GFSK
	Band 14	758-768	LTE	64 QAM
27	700MHz LTE	698 - 758	LTE	64 QAM
90	800MHz Public Safety	851 – 854, 854- 861 862 - 869	P25	C4FM (QPSK)
			OpenSky	4-level GFSK
	800MHz SMR	851 – 854, 854- 861 862 - 869	FM & EDACS	FM ±5.0kHz dev'n
	900MHz ESMR	935 - 940	LTE	64-QAM
	800MHz ESMR	854 – 861 862 - 869	EVDO (QPSK+QAM)	QPSK + QAM
			FD-LTE	QPSK + QAM
22	Cellular	869 - 894		
			UMTS	QPSK
			HSPA/HSPA+	16-QAM/64-QAM
			CDMA	QPSK
			CDMA2000 Ev-DO	8PSK, 16-QAM
	929 Paging	929 - 930	FSK	FSK
	931 Paging	931 - 932	FSK	FSK

Rule Part	Band	Downlink Frequency Range (MHz)	Service	Modulation
24	PCS	1930 - 1995	GSM	GMSK
			EDGE	8-PSK
			UMTS	QPSK
			HSPA/HSPA+	16-QAM/64-QAM
			FDD LTE (band 2/25)	QPSK + QAM
			CDMA	QPSK
			CDMA2000 Ev-DO	8PSK, 16-QAM
27	AWS	2110 - 2180	UMTS	QPSK
			HSPA/HSPA+	16-QAM/64-QAM
			FD-LTE (band 4)	16-QAM/64-QAM
			FD-LTE (band 10)	16-QAM/64-QAM
	AWS-4	2180 – 2200	FD-LTE	16-QAM/64-QAM
	WCS	2345 - 2360	FD-LTE	16-QAM/64-QAM
	BRS/EBS	2496 – 2690	LTE	16-QAM/64-QAM

The Remote Unit is a Licensed Transmitter with authorization to transmit the services. See the Technical Specification for more information.

FCC Cautionary note

Any changes or modifications in construction of this equipment which are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Verification : Primary and Secondary Hub

This device complies with part 15 of the FCC Rules. Operation is subject to the followings two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This is a Class A Digital Device

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Note: This is Class A product (as defined in EN 55032). In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

Innovation, Science and Economic Development Canada compliance statement

The nominal passband gain is 25 dB and the nominal bandwidth is 150 MHz to 2.94 GHz. The rated mean output power is 20 dBm and the input and output impedances are 50 ohms.

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

WARNING: This is NOT a CONSUMER device. It is designed for installation by an installer approved by an ISED licensee. You MUST have an ISED LICENCE or the express consent of an ISED licensee to operate this device.

CE Information

UNItivity complies with the essential requirements of the Radio Equipment Directive (2014/53/EU) and is therefore 'CE' marked when it is used in accordance with the instructions provided in this Manual.

CE Declaration of Conformity

This equipment has been tested and found to comply with the limits set out by the Directive 2014/53/EU.

Hereby, Zinwave Ltd, declares that this Distributed Antenna System is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

Zinwave Ltd, vakuuttaa tŠten että Distributed Antenna System tyyppinen laite on direktiivin 2014/53/EU oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.

Hierbij verklaart Zinwave Ltd, dat het toestel Distributed Antenna System in overeenstemming is met de essenti'le eisen en de andere relevante bepalingen van richtlijn 2014/53/EU

Bij deze verklaart Zinwave Ltd, dat deze Distributed Antenna System voldoet aan de essenti'le eisen en aan de overige relevante bepalingen van Richtlijn 2014/53/EU.

Par la prŽsente, Zinwave Ltd, dŽclare que ce Distributed Antenna System est conforme aux exigences essentielles et aux autres dispositions de la directive 2014/53/UE qui lui sont applicables

HŠrmed intygar Zinwave Ltd, att denna Distributed Antenna System stŒr I šverensstŠmmelse med de vŠsentliga egenskapskrav och švriga relevanta bestŠmmelser som framgŒr av direktiv 2014/53/EU.

Undertegnede Zinwave Ltd, erklærer herved, at følgende udstyr Distributed Antenna System overholder de væsentlige krav og øvrige relevante krav i direktiv 2014/53/EU

Hiermit erklŠrt Zinwave Ltd., dass sich dieser Distributed Antenna System in †bereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 2014/53/EU befindet

ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Zinwave Ltd, ΔΗΛΩΝΕΙ ΟΤΙ Distributed Antenna System ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 2014/53/ΕΕ

Con la presente Zinwave Ltd, dichiara che questo Distributed Antenna System è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 2014/53/EU.

Por medio de la presente Zinwave Ltd, declara que el Distributed Antenna System cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 2014/53/ UE

Zinwave Ltd, declara que este Distributed Antenna System está conforme com os requisitos essenciais e outras disposi?›es da Directiva 2014/53/EU.

RoHs Information

This equipment fully complies with the requirements set out in the RoHS Directive. DIRECTIVE 2011/ 65/EU

About this Manual

This manual provides installation and configuration instructions for the UNItivity 5000 in-building wireless solution. It describes installation of individual components, connection of each device to another, and configuration of devices.

Intended Audience

The intended users for this manual are trained and competent in the professional installation of rack mounted equipment and familiar with the configuration of Distributed Antenna Systems (DAS).

Conventions

Various types of pictures or icons are used in this service manual wherever they reinforce the printed message to alert you to potential safety hazards in one of the following ways:.

⚠️	**Warning:** A warning notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a Warning notice until the indicated conditions are fully understood and met.
⚠️	**Caution:** A caution notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a caution notice until the indicated conditions are fully understood and met.
⚠️	**Sensitive to electrostatic discharge caution:** An Electrostatic Discharge (ESD) Susceptibility symbol is displayed to alert personnel that the part(s) are sensitive to electrostatic discharge and that static control procedures must be used to prevent damage to the equipment.
Bold	Actions you should take such as text or data to be typed exactly or items to click.
Italics	Items to type for which you must supply a value.
Screen Name	Screen Names are in initial caps.

Note: A note provides additional information to clarify a point in the text.

Important: An Important statement is similar to a note, but is used for greater emphasis.

Getting Help

Help for the Configuration GUI is available by clicking the Help button. If you need further assistance, please contact Zinwave support at support@zinwave.com or your service partner.

Chapter 1: System Overview

Zinwave's UNItivity 5000 in-building wireless solution provides cellular and public safety access services to buildings, campuses, and venues, delivering end-to-end all fiber service on a single converged system. Zinwave's unique wideband architecture supports any service mix, protocol, or modulation scheme from 150MHz to 2700MHz. UNItivity 5000 provides RF coverage over large areas and supports a multitude of wireless and IP data services, irrespective of carrier frequency or signal protocol.

The components of UNItivity 5000 are:

- Primary Hub
- Service Module - installed in Primary Hubs
- Optical Module - installed in Primary Hubs
- Secondary Hub – incorporates 48V DC Power Supply Unit (PSU) for Remote Units
- Remote Unit
- Configuration Graphical User Interface (GUI) - supplied on Primary Hubs
- Active Point of Interface (POI) device (optional) - head-end connection between high power RF source and Primary Hubs
- Small Cell Point of Interface unit (Optional) - provides a simple head end connection between a small cell (up to 4) and a Primary Hub
- Central 48V DC Power Supply (Optional) – used for powering any Remote Units directly connected to Primary Hub

The system's network infrastructure uses standard structured cabling, broadband Single-mode optical fiber.

1.1 How Does It Work?

At a high-level, the standard solution provides a complete in-building wireless infrastructure with a few core components. Radio Frequency (RF) source inputs come into the Primary Hub's Service Module directly or through one of the optional POI products. The Primary Hub converts these RF signal inputs to optical and connects via optical fiber directly to Remote Units or to a Secondary Hub. The

Secondary Hub connects via optical fiber directly to Remote Units. The Remote Units connect to antennas, taking the optical signal back to RF and amplifying it for wider distribution.

System Overview
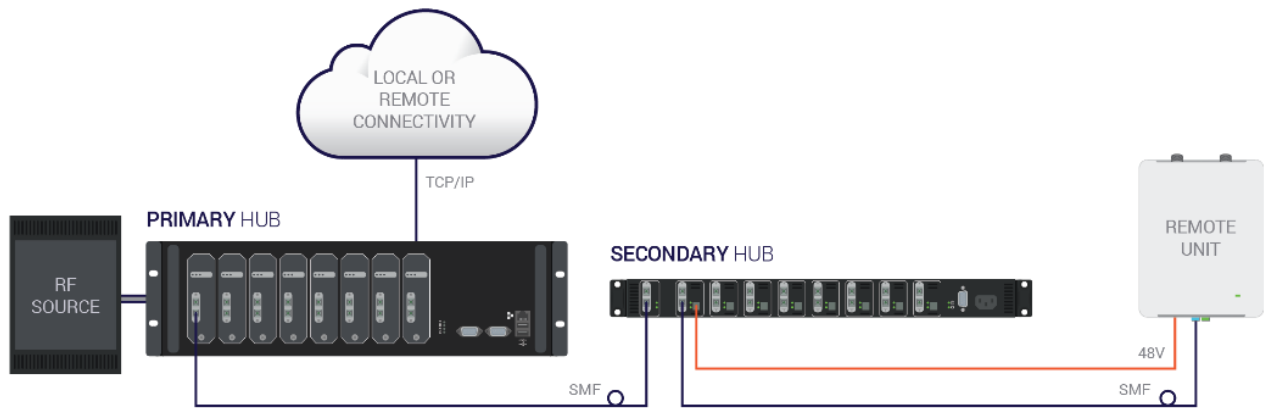
1.1.1. Real World Examples

The following illustrations show the UNItivity 5000 solution applied to a single building and across a campus.

1.1.1.1. Single Building Example

In this illustration, the POI and Primary Hub are located in the basement with local access via a laptop.The POI routes RF inputs into the Service modules on the rear of the Primary Hub. Remote Units, scattered throughout the building, are connected to Optical Modules on the front of the Primary Hub. A Secondary Hub, located on the upper floors, is also connected to the Primary Hub.

Additional Remote Units are connected to the Secondary Hub. Antennas are placed in the ceilings and connected to the Remote Units.
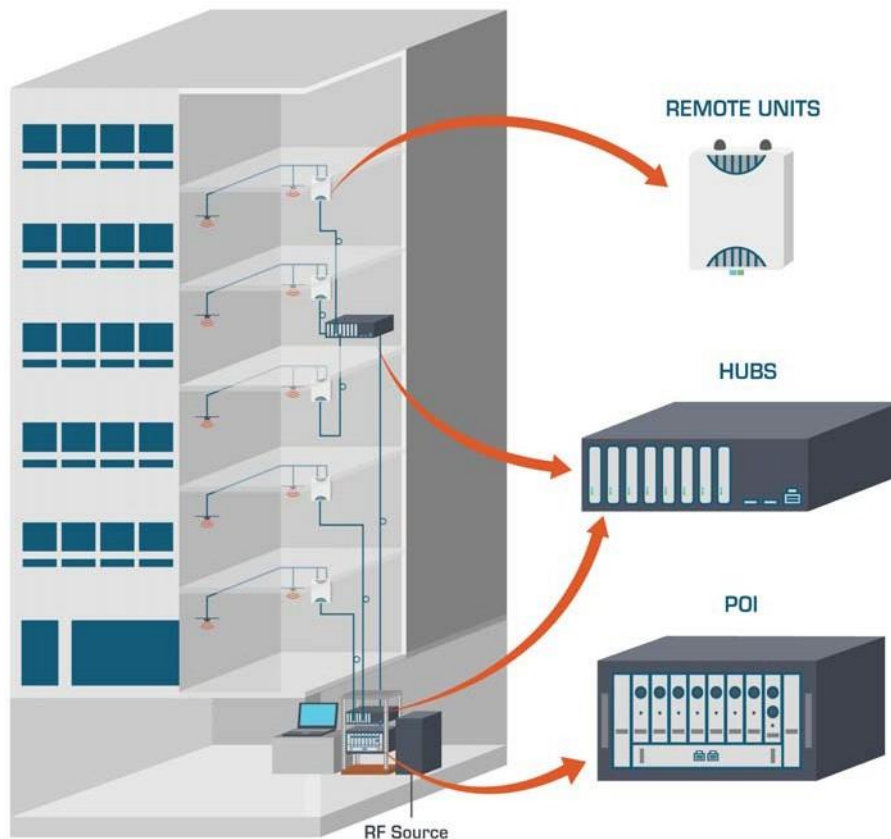
1.1.1.2. Campus Example

In this illustration, the POI, Primary Hub, and Secondary Hub are located in the basement of the building to the left. The POI routes RF inputs into the Service Modules on the rear of the Primary Hub. Multiple Secondary Hubs are connected to the Optical Modules in the front of the Primary Hub. These Secondary Hubs are located in buildings throughout the campus. Remote Units are connected to the

Secondary Hubs. Antennas are placed in the ceilings and connected to the Remote Units.
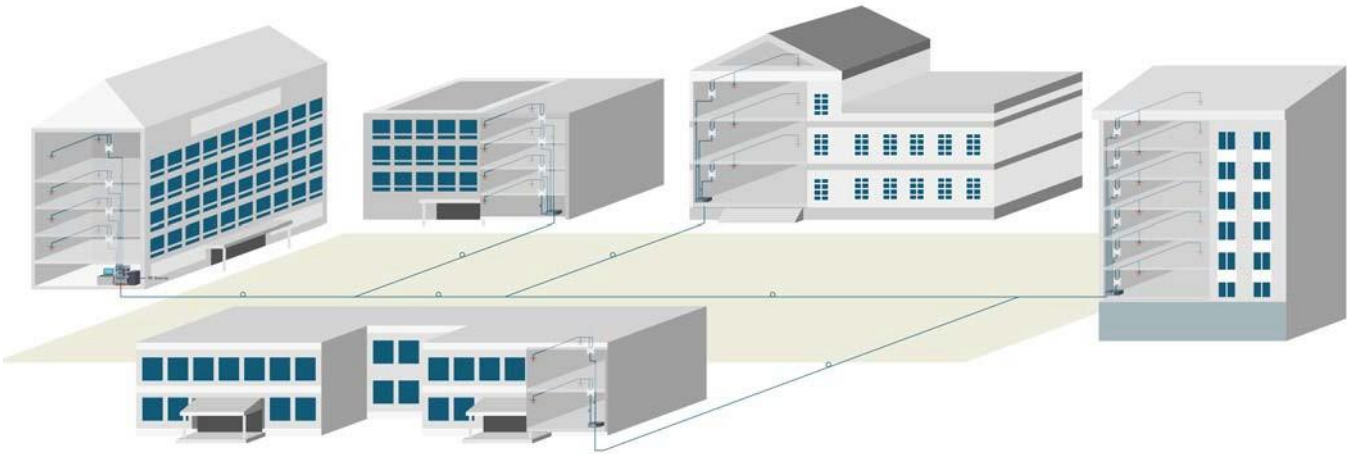
1.2 Key Features

The UNItivity 5000 solution provides the following key features:

- Wideband 150Mhz - 2700 MHz capability
- Supports single star or double star topologies, supporting up to 64 Remotes.
- Singlemode Fiber (SMF) from head-end to antenna
- Supports Frequency Division Duplex (FDD) and Time Division Duplex (TDD)
- Modular Primary and dedicated Secondary Hubs, with 48V PSU functionality for powering Remote Units incorporated in Secodary Hub.
- Extensive cable support with long distances possible following an accurate measurement for optical loss (5dBo max). With modal bandwidth of at least 500MHz.km @1300 nm
- Self-calibrating system - gain levels adjusted automatically to accommodate different cable length and optical losses.
- Hot-swappable Modules
- Web-based configuration and management system including SNMP v3 monitoring.
- Unique service distribution matrix on the Hubs provides flexibility to how the services are routed within a deployment.

1.3 Network Topologies

UNItivity 5000 supports a number of configuration topologies making it a flexible system that can support small venues to very large facilities and campuses. This, coupled with UNItivity 5000's wideband attributes enables system growth for both coverage of additional areas or buildings, or for adding support for new frequencies, wireless operators or services. The UNItivity 5000 system can range from a single Primary Hub and Remote Unit (a 1-1 configuration) to a maximum configuration consisting of a Primary Hub, 8 associated Secondary Hubs, and 64 Remotes (a 1-8-64).

1.3.1. Single Star Configuration

In its single star fiber-to-antenna topology, UNItivity 5000 supports a Primary Hub with up to 8 Remote Units.
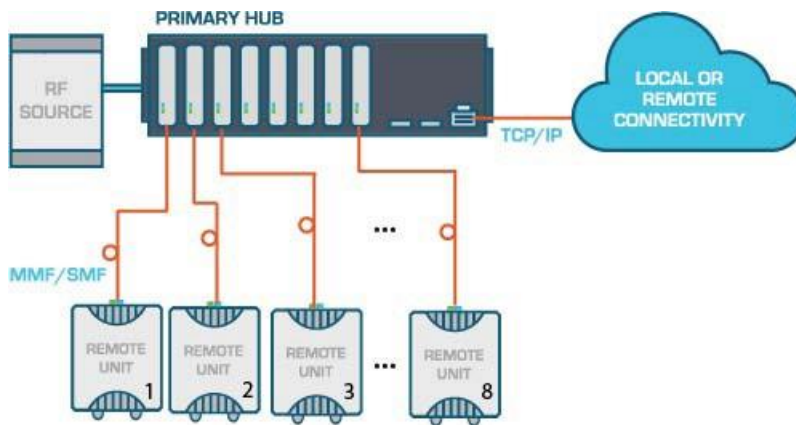
1.3.2. Double Star Configuration

In its double star configuration, UNItivity 5000 supports a single Primary Hub connected to up to 8 Secondary Hubs each supporting 8 Remote Units, bringing the system total to up to 64 Remote Units.
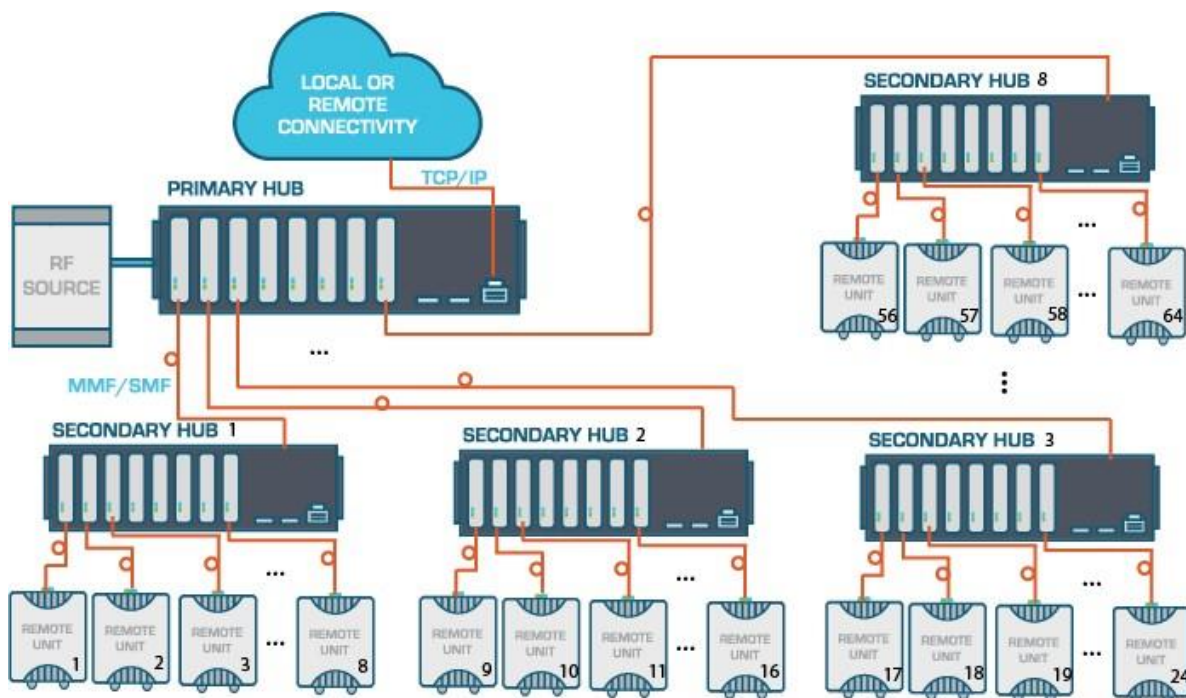
The UNItivity 5000 system can also support a mixed topology, such that Remotes can be directly connected to the Primary Hub (single star configuration) while also supporting Secondary Hubs connected to the same Primary Hub (double star configuration). A typical mixed topology use case has a location

needing coverage that is in close proximity to the Primary Hub, while also needing to support longer fiber runs or other buildings from that same Primary Hub such that it would be necessary to deploy a Secondary Hub. In this case, the total number of Remote Units that can be supported from the Primary Hub is a function of the number of Remotes which are directly connected to the Primary Hub. For example, if 4 Remote Units were directly connected to the Primary Hub then only 4 Secondary Hubs could be simultaneously supported, with the resulting maximum total number of Remotes supported off the Primary equal to 36 (4 directly connected Remotes + 32 Remotes connected via the 4 Secondary Hubs).
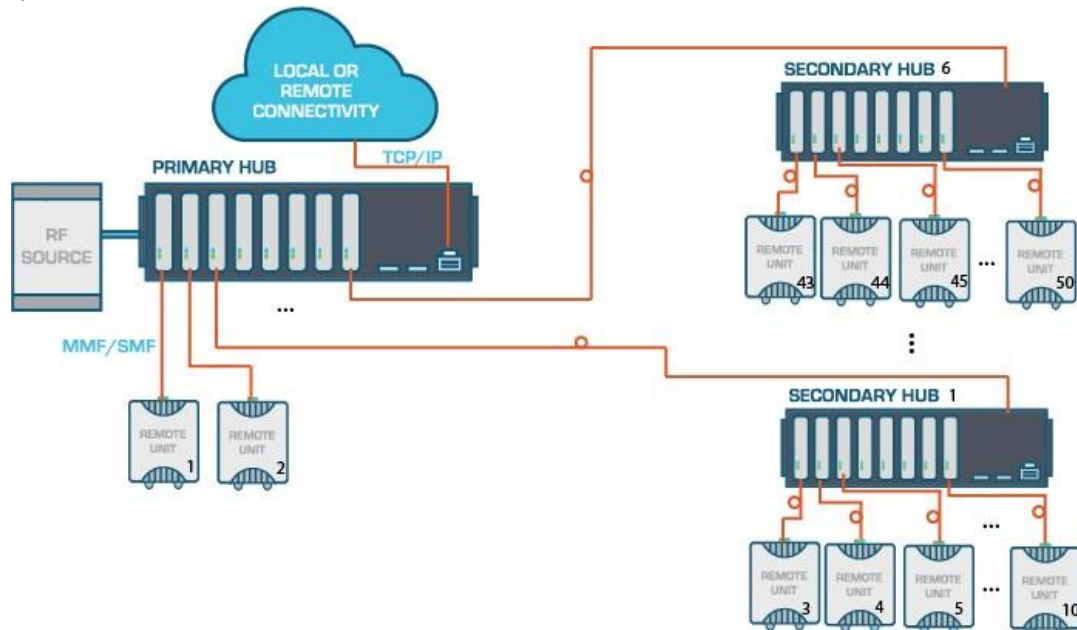
1.3.3. Network Cabling

All cabling is done via optical fiber. The transceivers within the Hubs and Remote Units are intended for use with 9/125 µm SMF terminated in SC/APC connectors.

Extensive cable lengths can be delivered, using the same core components. This length of interconnection is more than adequate to facilitate a high quality, broadband, in-building coverage extension system for multiple, simultaneous wireless feeds for cellular and public safety as well as anything from 150 MHz to 2700 MHz.

1.3.4. Support For MIMO Services

The next generation of high data-rate services such as LTE provide various multiple-input and multiple-output (MIMO) options. Where base stations (BTS) are deployed to provide in-building coverage, these options can be used to increase the overall capacity or coverage of the system.

Typically, BTS signals are distributed inside buildings via a Distributed Antenna Systems (DAS) which has multiple antenna locations to provide multiple copies of each signal. In the case of MIMO, each antenna location will require 2 or more independent signals from the same BTS. The standard UNItivity 5000 single star and double star architectures support a traditional single signal (SISO) BTS. See "Single Star Configuration" on page 1-5 and "Double Star Configuration" on page 1-5.

In the case of a single star topology, 8 Remotes would have 16 antennas. For double star at a capacity of 8 Secondary Hubs, each with 8 Remote Units, you could have 64 Remotes Units with a total of 128 antennas at 64 antenna locations. Each location consists has 1 Rx and 1 Tx antenna.This architecture has to change to support a dual-transceiver MIMO BTS.

In a full MIMO double star configuration, there would be 1 Primary Hub and 8 Secondary Hubs. Of these, 4 would be carrying MIMO A and 4 MIMO B. Each Secondary Hub still connects to 8 Remote Units: however, now 32 of those units have MIMO A and the 32 MIMO B.

If the MIMO installation still uses SISO antennas, the number of antennas remain the same at 128, 64 for MIMO A and 64 for MIMO B. This is because each location now has 2 Remote Units with 2 Tx and 2 Rx antennas. The number of antenna locations is now 64.

System Overview

If MIMO antennas (which have 2 RF connections) are used, the number of antennas is 32 for MIMO Tx and 32 for MIMO Rx. The number of antenna locations is now 32.

MIMO Configuration

Single Primary Hub feeding 8 Secondary Hubs, 64 Remote Units connected to 64 MIMO antennas to provide 32 areas coverage
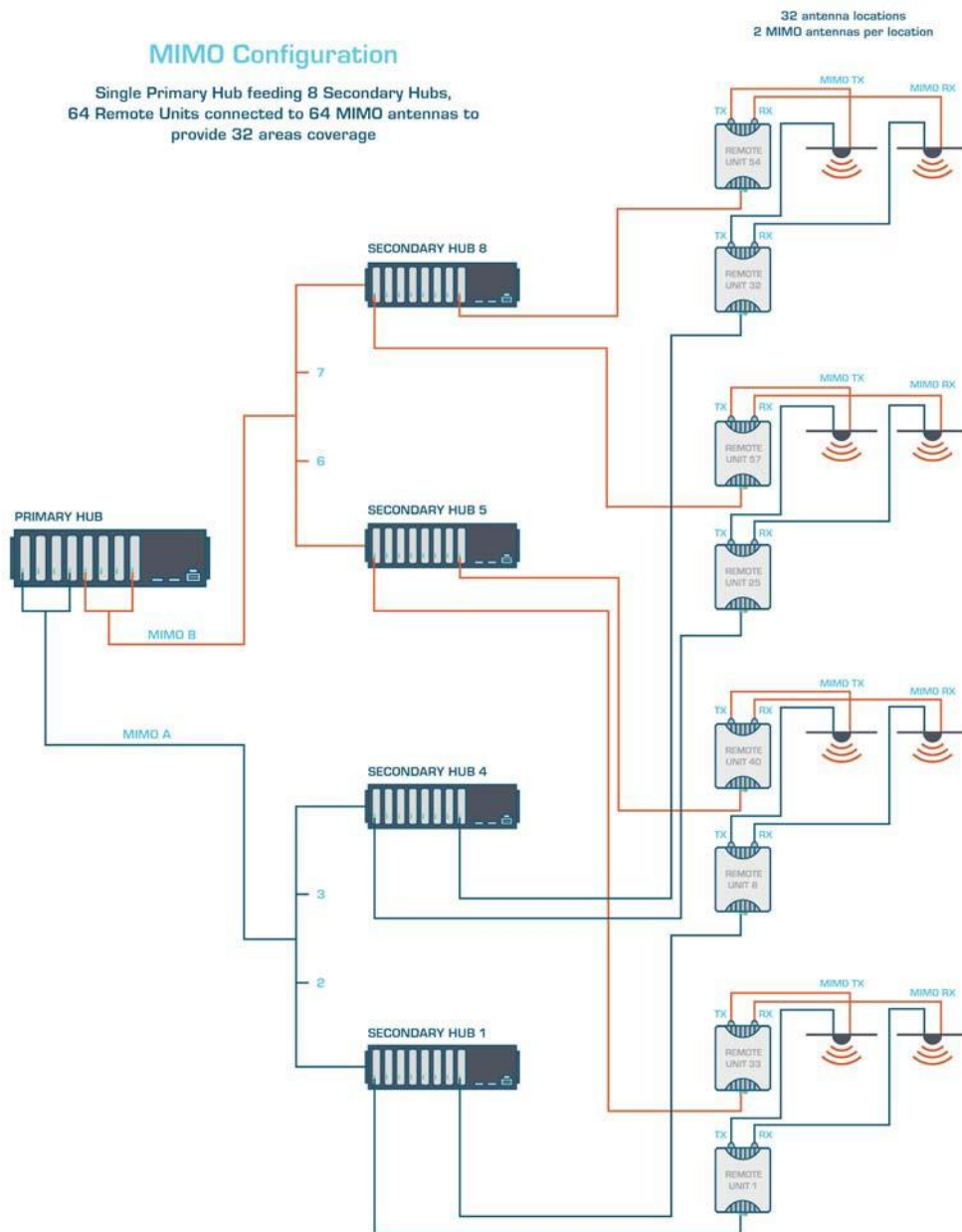
Note: The MIMO routing is done via the Signal Routing Matrix in the Primary Hub.

1.4 Understanding Optional Components

You can enrich the standard UNItivity 5000 solution by incorporating optional components. Optional components enhance system input capability or the operation of a core component. The POI expands system RF input capability while the stand-alone PSU provides a simple install power capability for Remote Units connected directly to the Primary Hub.

1.4.1. How the PSU Fits in

The Central 48V DC Power Supply is a 1U rack mountable unit that can be used to power Remote Units directly connected to the Primary Hub. This 600W unit provides eight 48V outputs on terminals supporting twin core cabling. It would typically be co-located with the Primary Hub, and can be monitored via a USB port on the Primary Hub. Secondary Hubs incorporate similar Power Supply functionality as standard.
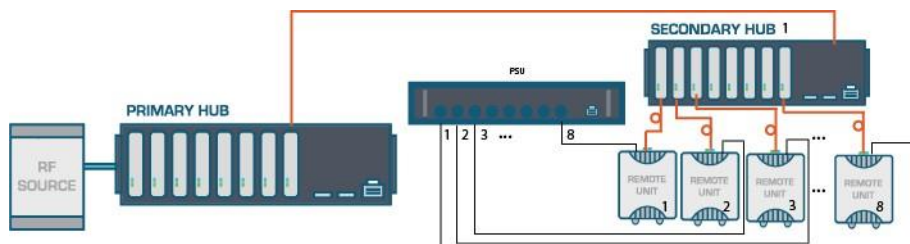
1.4.2. How the Active POI Fits in

The Active POI provides the interconnection between the RF source (for example, high power sources like BTS or repeaters where significant attenuation is needed) and the Service Module that is installed in the Primary Hub. It's compact design provides multiple passive elements for signal conditioning/attenuation.

The POI integrates directly to the UNItivity 5000 system and includes overload protection, filtering, attenuation, and combining/splitting. Reliability is designed in with a single point of connection to BTS Duplex and a Simplex connection to the Primary Hub.
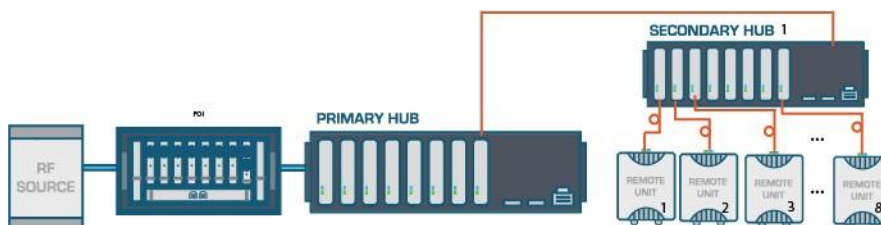
1.4.3. How the Small Cell POI Fits in

Small Cell Point of Interface (SC-POI), provides a low cost, easy to install point of interface panel enabling quick and easy deployment and integration of up to 4 small cells per panel with Zinwave's UNItivity 5000 solution.
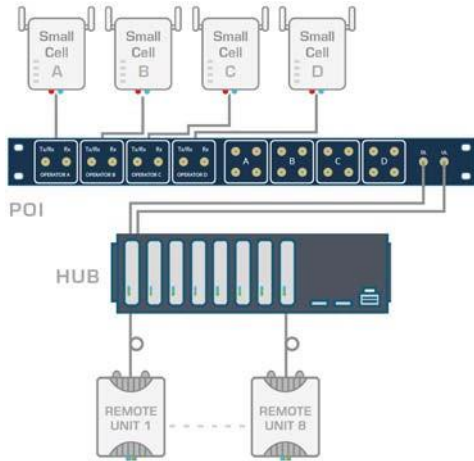
1.5 Understanding Service Distribution

UNItivity 5000 supports any service mix, protocol, or modulation scheme from 150MHz to 2700MHz. That means it can take inputs from a variety of RF source inputs such as wireless and IP data services from mobile data carriers and base stations. To handle this, UNItivity 5000 uses a software-defined service distribution matrix. This means specific operators or frequencies can be routed to the entire system or to designated sections of the system, depending on requirements. The matrix (as defined by the user) routes various signals from a Primary Hub to Secondary Hubs. The picture below shows how a variety of inputs can be routed in a campus environment.
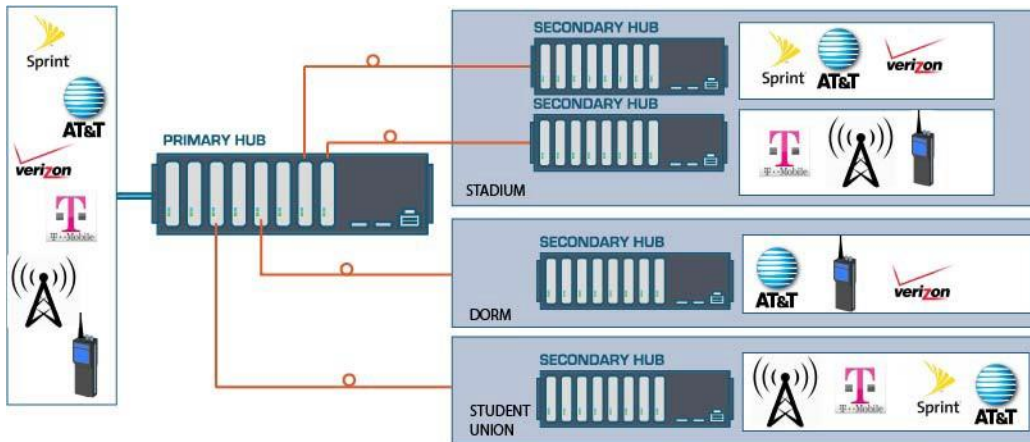
Chapter 2: Understanding the Components

UNItivity 5000 has core and optional components. Core components are all necessary for system operation. Core components include:

- Primary Hub
- Service Module
- Optical Module
- Secondary Hub
- Remote Unit
- Optical Fiber
- Configuration GUI (supplied with the Primary Hub)

In addition to the core components, optional components are available to enhance the system's capabilities. Regardless of the addition of optional components, a double star topology remains scalable to 64 Remote Units. Optional components include:

- Central 48V PSU (1U - 600W)
- POI (Active and Small Cell)

2.1 Hubs

A UNItivity 5000 system consists of a single Primary Hub at the head-end, and up to 8 connected Secondary Hubs. Both Hubs have a universal AC power input.

2.1.1. Primary Hub

A Primary Hub provides the interface to the RF sources and converts RF signals to optical. It then connects via fiber to either Secondary Hubs and/or Remote Units.

The Primary Hub includes at least one Service Module (see "Service Module" on page 2-4). Service Modules interface with RF sources such as base stations or repeaters. The Hub can be equipped with up to four Service Modules (installed in the rear) to accept any combination of frequencies between 150MHz-2700MHz, and up to 8 Optical Modules (located at the front, see "Optical Module" on page 2-5) to connect via optical fiber to Secondary Hubs or Remote Units directly. The Primary Hub supports single or dual star configurations or a mix of both. The Primary Hub is normally co-located with BTS or RF source equipment.

Understanding the Components

2.1.1.1. Front View

The Primary Hub may be delivered with up to 8 Optical Modules. See "Optical Module" on page 2-5 for more information on Optical modules.
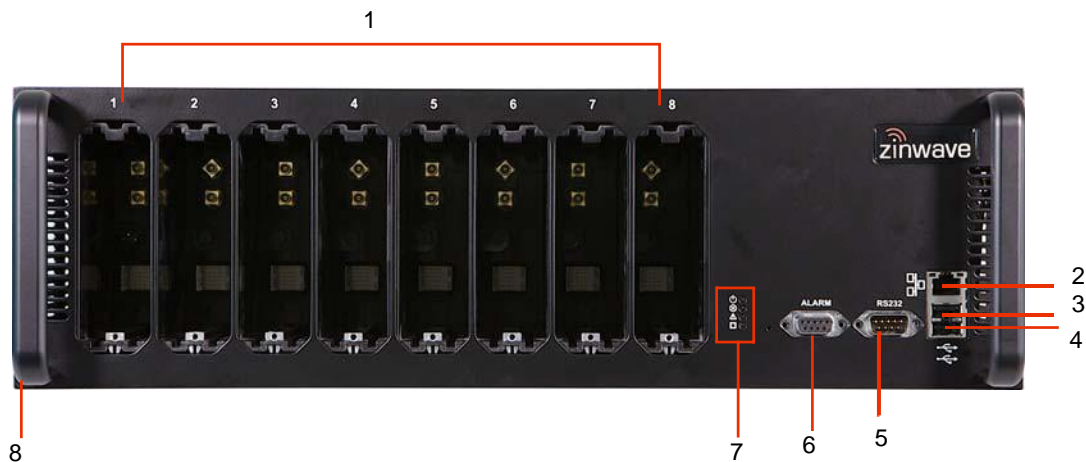
Number	Description
1	Slots1 to 8 for Optical Modules
2	Ethernet connector
3	USB Connector (Type A)
4	USB Connector (Type A)
5	RS232 Connector
6	Alarm Connector (9 way D-type)
7	Status LEDs
8	Handle and Mounting Bracket (both sides of device)

2.1.1.2. Rear View

The Primary Hub may be delivered with up to 4 Service Modules. See "Service Module" on page 2-4 for more information on Service modules.

Number	Description
1	Slots A to D (left to right) for Service Modules
2	Grounding Post
3	IEC AC Power Cord Connector shown. For DC power connection callouts and details see "DC Powered Hub" on page 5-6.
4	Fuse
5	On/Off Power Switch

2.1.2. Secondary Hub

A Secondary Hub receives input via an optical link from a Primary Hub to distribute RF feeds between the Primary Hub and Remote Units. The Secondary Hub supports fiber connections to up to 8 Remotes as standard. As the Secondary Hub can be located far from the Primary Hub, the deployed architecture can be tailored to meet and work with building layout and location of appropriate equipment rooms. The Secondary Hub can be collocated with the Primary Hub or distributed throughout the site as appropriate.

Understanding the Components

2.1.2.1. Front View

Number	Description
1	Duplex SC/APC Optical connection to Primary Hub
2	Duplex SC/APC Optical connection to Remote Unit (8 positions)
3	Phoenix Contact 5.08mm connector: 48V power for Remote Unit (8 positions)
4	Alarm Connector (9 way D-type)
5	IEC AC Power Cord Connector

2.2 Service Module

Service Modules provide the interface to the RF signal source such as BDA, BTS, or small cell. The modules are hot swappable units, allowing either system maintenance or the addition of operators or frequencies to be done without disrupting service. Up to 4 Service Modules can be deployed in the back of a Primary Hub.

2.2.1. Front View
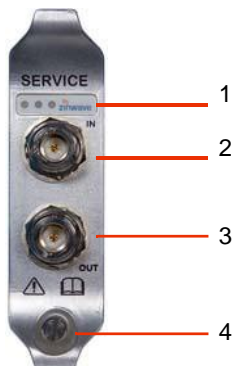
Number	Description
1	Status LEDs
2	RF Input N type
3	RF Output N type
4	Retaining Screw

2.2.2. Rear View
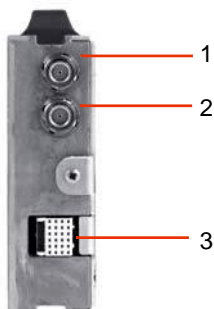
Number	Description
1	Floating BMA RF Connector
2	Floating BMA RF Connector
3	Multi-pin Data and Power Connector

2.3 Optical Module

The Optical Module provides the fiber link between a Primary Hub and a Secondary Hub or a Remote Unit. Up to 8 Optical Modules can be installed in the front of a Primary Hub to connect to Remote Units or Secondary Hubs as required. These modules are hot

swappable to allow for system maintenance or adding Secondary Hubs or Remote Units with no impact to service. Optical Modules are intended to connect only by optical fiber.

2.3.1. Front View
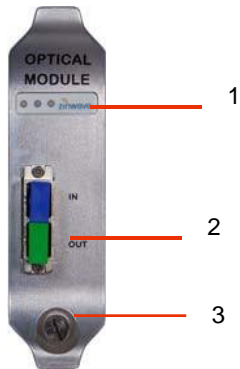
Number	Description
1	Status LEDs
2	Optical Fiber connector (Duplex SC/APC connector)
3	Retaining Screw

Optical Modules are intended to connect via Zinwave patch cords.

2.3.2. Rear View
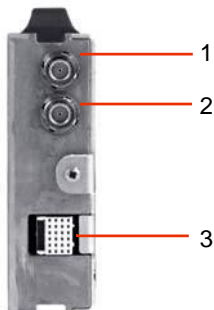
Number	Description
1	Floating BMA RF Connector
2	Floating BMA RF Connector
3	Multi pin Data and Power Connector

2.4 Remote Unit

The Remote Unit is a small, wall or ceiling mountable unit that amplifies the received signals for transmission over a wireless link, in the case of the downlink signals, and amplifies the received wireless signals for transmission over the optical link, in the case of the uplink signals. It is connected to the Primary or Secondary Hub via optical fiber. It converts the wireless signal from optical to RF (and vice-versa) and amplifies it for transmission to or from a mobile device. It defines the final cell coverage, communicates via optical link to Hubs, and receives and amplifies signals from smart phones, tablets, laptops, and other hand-held devices.

Understanding the Components

2.4.1. Bottom View
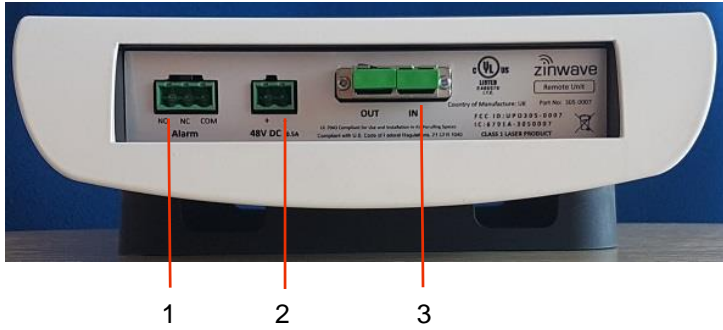
Number	Description
1	Phoenix Contact 5.08mm Connector 3-way: Alarm Relay
2	Phoenix Contact 5.08mm Connector 2-way: 48V DC Input
3	Optical Fiber connector (Duplex SC/APC connector)

2.4.2. Top View

Number	Description
1	Antenna Connector Receive (Tx) Coax N type
2	Antenna Connector Transmit (Rx) Coax N type

2.4.3. Antennas

A variety of antennas can be connected to the Remote Unit via short coaxial cables.The choice of antenna will depend on the service requirement within the operational bandwidth of the system. It is important to ensure that any installed antennas meet the Tx/Rx isolation requirements and that they are installed in accordance with all relevant safety and exposure regulations. See *"Understanding Antennas" on page 7-1* for detailed antenna information.

2.5 Fiber Patch Cords

Duplex SC/APC type fiber connectors are used on the Optical Module, Secondary Hub and Remote Unit. The system uses a laser in the transmit direction and photodiode in the receive direction. UNItivity 5000 is intended to be deployed with Single-mode fiber infrastructure. Zinwave supplies various fiber patch cords with the correct duplex SC/APC terminations

for the Zinwave UNItivity equipment, and other optical connectors as required to match the installed infrastructure. The Duplex SC/APC connectivity is shown below:
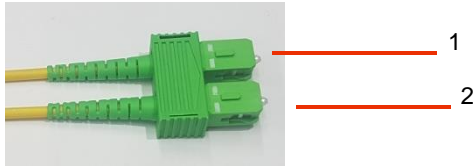
Number	Description
1	Out - transmit (laser)
2	In - receive (photodetector)

The TIA 568 color code for connector bodies and/or boots is Beige for Multimode fiber, Blue for Singlemode UPC fiber connector, and Green for Singlemode APC (angled polished) connectors.

2.6 Central 48V PSU (Optional)

Remote Units connected directly to a Primary Hub may be powered by the Zinwave optional Remote 48V central power supply unit. Up to 8 Remote Units can be powered by this 600W PSU. The PSU can be connected to the Primary Hub using a standard USB cable, to enable PSU status monitoring.

1U

Central 48V PSU (Optional)

Understanding the Components

2.6.2. 1U - 600W

2.6.2.1. Front View
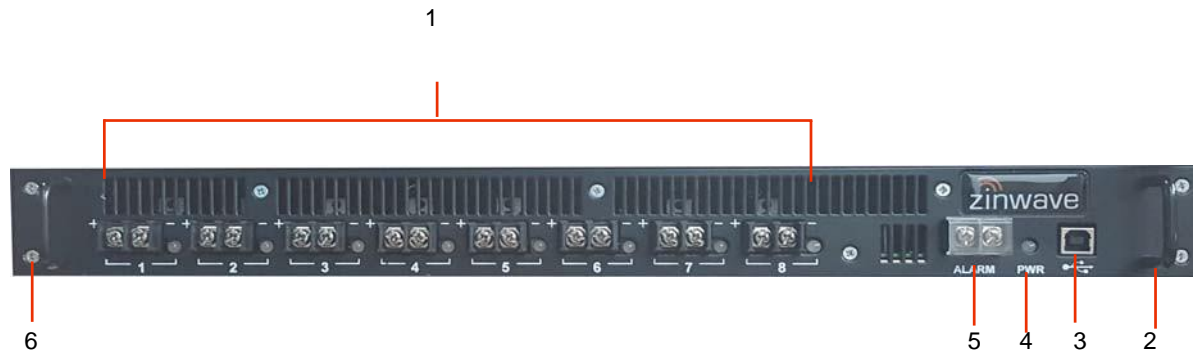
Number	Description
1	8 Power connector slots with screw terminals (LED for each)
2	Handle
3	USB Connector (Type B)
4	Power LED (indicates power connected to device)
5	Alarm interface - (connect to local fire panel)
6	Mounting Bracket

2.6.2.2. Rear View

.

Number	Description
1	Grounding Post
2	IEC Power Connector
3	On/Off switch

2.7   POI (Optional)

2.7.1.   Active POI

The Active POI provides head-end functions (e.g., overload protection, filtering attenuation and combining/splitting) between the RF sources such as base stations and repeaters and the Service Module installed in the Primary Hub. You can have two POIs per Primary Hub. The POI consists of a single 19" rack-mountable chassis containing up to 8 service specific modules that provide the duplex RF interface to the RF source and the high power attenuation along with 1 or 2 wideband conditioning modules that provide the active RF control and monitoring functions (variable attenuation, power monitoring, ALC, overload protection) and a 4-1 combining/splitting function.

See the *UNIconnect POI Manual* for detailed information about this device, including front and rear views.

2.7.2.   Small Cell POI

The Small Cell POI is a compact single panel (1U) device that integrates up to four small cells for connection to the UNItivity 5000 system. It can support any frequency from 700MHz – 2700MHz.

The interface is configurable for duplex or simplex operation for each small cell. There are user-selectable attenuation options, that support the most common Small Cells on the market. No electrical power is required. This purely a passive connection between the Small Cell and the UNItivity 5000 platform

2.7.3. Front View
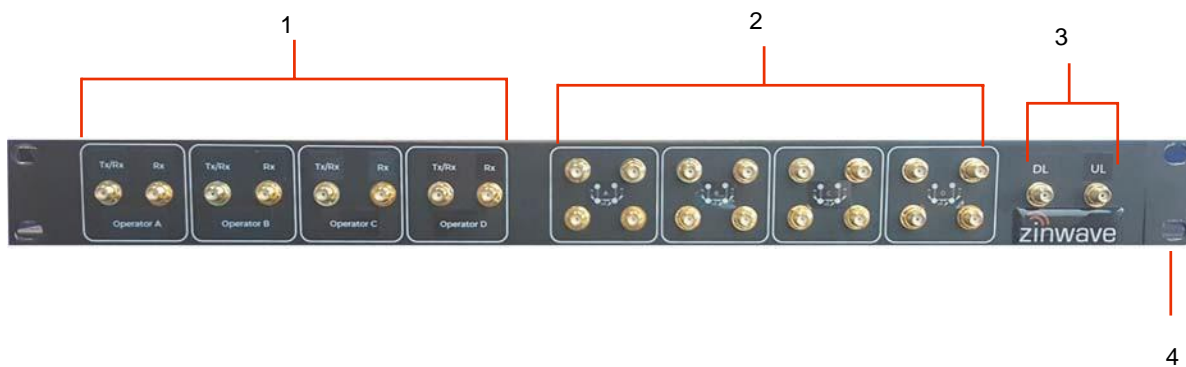
Number	Description
1	4 pairs SMA connectors each pair Tx/Rx and Rx connections
2	4 sets of 4x SMA – 4x Attenuator selection
3	2x SMA connectors (DL and UL) for interface to Zinwave Hub (service module)
1	Mounting Bracket

There are no connectors on the rear of this device.

2.8 Configuration GUI

The Configuration GUI is delivered with and resides on the Primary Hub. It provides all the parameters needed to configure and monitor Primary Hubs, Secondary Hubs, and Remote Units. This web-based application is accessible via standard browsers and provides SNMP support to integrate with SNMP monitoring tools for alarm notification.
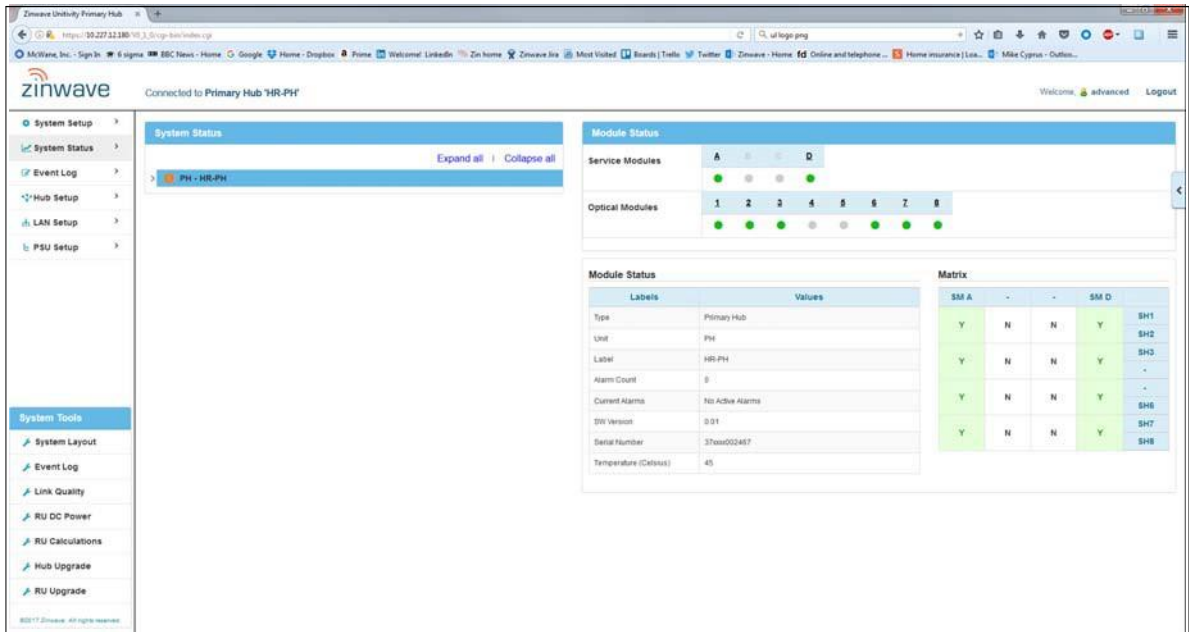
Chapter 3: Primary Hub and Module LEDs

3.1 Primary Hub Front Panel LEDs

There are four LEDs on the front of the Primary Hub. The following table describes them:

Symbol	Name	Status Color	Description	Comment
⏻	Power Indicator	Green	Power connected to CPU board	Shows processor is correctly powered
		Off	No power connected	
⊗	Service Indications	Green	No error. System is fully functional	This alarm cannot be masked and will ALWAYS be Red when loss of service conditions active.
		Red	Loss of service currently active	
		Red/Green Flashing	Firmware programming in progress	
⚠	Warning Indicator	Green	All Units operating correctly	
		Orange	Service or Hardware warning currently active	
▢	CPU Indicator	Green	CPU running	Shows Processor is correctly operational
		Orange	CPU restarting	

3.2 Service and Optical Module LEDs

There are three LEDs on the front of each module which indicate operational status.

- The right LED indicates power status.
- The middle LED indicates communication status between the module and the far end.
- The left LED indicates the current state of the module.

As part of the auto discovery process the Hub communicates with each module in turn, and cycles through the installed modules. During this period, the Primary Hub checks for the presence of any Secondary Hubs and Remote Units. If none are found, the unit cycles to the next module.

For Optical Modules, if no Remote Units are connected, only the right and middle LED's are operational.

Initially the right LED will be a dull red, indicating that power is connected but the module is disabled. This will change to green as the Hub detects the presence of the module. As the unit polls each of the installed modules, the right LED shows green. The middle LED shows green if the unit has successfully discovered one or more downstream system elements connected to the Optical Module. Only when a Remote Unit is detected will the third LED be activated.

A fully functioning module with fully operational downstream elements displays three green LEDs.

3.2.1. Power LED - Right

LED	Color	Description
🔴	Dull Red	Initial power-up. Power present on Hub allowing Module detection to proceed; or
		Module NOT Enabled through System Setup; or
		Module not inserted in valid Hub slot.
🟢	Green	Module in normal operation. Ready for use (Power to module).
⚪	Off	No power to module.

3.2.2. Communications - Middle

Once plugged in, the Optical module attempts to establish communication with the far end.

Service Modules do not communicate with Remote Units or other Hubs; therefore, the Communications LED is deactivated for Service Modules.

LED	Color	Optical Module Description
🔴	Solid Red	No successful communication with any downstream system elements after initial attempts.
🟢	Green	Module in normal operation. Communication established with at least one downstream system element.
⚪	Off	Module is not powered, or has not yet completed initial attempts to communicate with downstream system elements.

3.2.3. Status - Left

LED	Color	Service Module	Optical Module
	Off	Normal condition	Module is not powered, or optical calibration and auto-setup of downstream units not yet started.
	Green	Not Used	Optical Module and all downstream system elements operating normally.
	Flashing Green	Not Used	Optical link calibration and auto-setup of downstream units in progress; and/or One or more downstream Remote Units have their radio transceivers disabled.
	Red	Not Used	Optical calibration and auto-setup Error – For Possible causes refer to "System Status" page on GUI

3.3 Start-up Sequence

3.3.1. Service Module

The following table shows a typical LED start-up sequence for a fully enabled Service Module:

Left		Middle		Right		Status
	Off		Off		Dull Red	Initial power-up. Power present on Hub allowing Service Module detection; or Service Module NOT Enabled through System Setup; or Service Module inserted in invalid slot. (E.g. In an output (front) slot).
	Off		Green		Green	Service Module successfully detected and in normal operation; or Service Module with Service Warning; or Service Module with Service Loss.

3.3.2. Optical Module

The following table shows a typical LED start up sequence for a fully enabled Optical Module:

Left		Middle		Right		Status
	Off		Off		Dull Red	Initial power-up. Power present on Hub allowing Optical Module detection; or Optical Module NOT Enabled through System Setup; or Optical Module inserted in invalid slot. (E.g. In an input (rear) slot).
	Off		Off		Green	Optical Module successfully detected, starting discovery of downstream system elements.
	Off		Red		Green	Potential communication failure state: if no downstream system elements have responded after a number of communication attempts (discovery continues).
	Off		Green		Green	Communication success state: communication with at least one downstream system element successfully established.
	Green Flash		Green		Green	Optical calibration and auto-setup of downstream units in progress, and/or one or more downstream Remote Units have their radio transceivers disabled.
	Green		Green		Green	Optical Module and all downstream system elements operating normally.

3.4 Remote Unit LEDs

There is a single LED on the Remote Unit visible at the fiber end plate:

LED	Color	Description
	Off	No power to Remote Unit
	Red	No connection to Hub
	Red Flash	Alarm active
	Alternate Red/ Green	Associating with Hub
	Green Flash	Unit successfully associated with Hub. Optical link calibration and auto-setup in progress, and/or Remote Unit radio transceiver disabled.
	Green	Remote Unit fully operational

Installation and Configuration

Chapter 4: Performing a Basic Installation

The following procedure is intended to provide you with a basic work flow to get a new system up and running. It provides references to specific instruction for that step.

To install UNItivity 5000:

1. Unpack and verify all components (See section "Installing and Populating Hubs" on page 5-1 for Hubs).
2. Rack mount Hubs and populate with the appropriate modules (See section "Installing and Populating Hubs" on page 5-1).
3. Install Remote Units and antennas (See section "Installing Remote Units" on page 6-1 and "Connecting Antenna to Remote Units" on page 7-4).
4. Install power for Remote Units (local or PSU) (See section "Powering Remote Unit" on page 6-3).
5. Make and check all connections for power and data between Primary, Secondary, and Remote Units. This will be fiber for Optical Connections. (See section "Infrastructure and Cabling" on page 8-1).
6. Ground any Rack Mounted Equipment. See "Grounding Rack Mounted Equipment" on page 9-5.
7. Power on all equipment (See sections "Powering the Hub" on page 5-5 Hub and "Powering Remote Unit" on page 6-3 for Remote Units).
8. Watch LEDs for self-test and connection. (See section "Start-up Sequence" on page 3-4). Trouble shoot connections on infrastructure cables using LEDs (see "Hub and Hub Module LEDs" on page 3-1). Swap fibers and check power as needed.
9. Connect the PC to the Primary Hub to configure system. (See section "Initial Stand-alone Access" on page 11-1).
10. Access the GUI and view status pages (See section "Accessing the GUI" on page 11-1) and check firmware (See "Update Firmware" on page 12-1) for each Hub.
11. Set up the system based on the coverage tool and measured inputs. (See section "Understanding System Setup" on page 14-1).

Chapter 5: Installing and Populating Hubs

This chapter describes how to install insert modules into Primary and Secondary Hubs.

5.1 Installing the Hub

You can mount a Primary or Secondary Hub in a standard 19" rack or an open frame rack. There are many 19" rack systems available on the market of various depths. It is essential that the weight of the Hub is supported at the front. If the Hub is not adequately supported in your rack, you must provide support items, such as front-to-rear chassis runners (rails) or fully supported shelves. This manual provides instructions to mount a Hub in a rack using the only items supplied in the mounting kit.

5.1.1. Mounting Kit

Each Hub is delivered with an accessory box of parts used for rack mounting. This box contains the following parts:

Part Number	Qty	Detail	Function	Image
128-0118	8	Screw M4 X 10 CSK POZI STL BLACK	Mounting Bracket Screw	
142-0257-01	2	RACK MOUNTING BRACKET	Mounting bracket for rack	
142-0048-05	12	3000 HUB MODULE BLANK PLATE	Blanking plates for unused slots	
128-0043	12	SCREW THUMB 6-32X8MM PC CASE	Retaining Screws	
128-0113	4	M6 CUP WASHER BLACK	Mounting Bracket washers	
128-0112	4	SCREW M6x12 PAN POZI STL BLACK	Hub Mounting Screws (suitable for M6 Cage nuts, not supplied)	

Part Number	Qty	Detail	Function	Image
507-0003-02	1	EMS USB	Contains latest Hub software for	
	1	Power Cord	Country specific power cord	

5.1.2. Standard 19" Rack Mounting

The Primary Hub is deigned to mount directly into a 19 inch rack framework with no additional mounting materials.

The following tools are required for installation (Not provided):

- 4x M6 cage nuts appropriate for 19 inch rack frame
- Pozi-drive screwdriver
- Cage nut insertion/extraction tool

Note: If rack frame does not use M6 nuts, you must supply appropriate nuts to secure the Hub.

To install the Primary Hub in a rack:

1. Remove all parts from the Accessory Box included in the box with the Primary Hub.
2. Attach the mounting brackets (using the black countersunk screws 128-0118) to the side of the Primary Hub so that the mounting face is flush with the front of the Hub.

3. Using the cage/nut insert/extraction tool, install 2 M6 cage nuts on each side of the rack. The spacing must align with the holes in the Hub.
4. Place the Primary Hub into the rack and secure using screws 128-0112 and washers 128-0113.

5.1.3. Open Frame Rack Mounting

The Primary Hub is designed to mount into an open frame rack with an offset of either 75mm or 125mm (approx. 3 or 5 inches), using supplied mounting materials.

The following tools are required for installation (Not provided):

- 4x M6 cage nuts appropriate for 19 inch rack frame
- Pozi-drive screwdriver
- Washers and Screws, suitable for Rack type, to secure equipment

To install the Primary Hub in a rack:

1. Remove all parts from the Accessory Box included in the box with the Hub.

2. Attach the mounting brackets (using the black countersunk screws 128-0118) to the side of the Hub in the correct position for the rack.

3. Place the Primary Hub into the rack and secure using suitable Hub mounting screws and washers.

5.1.4. Installing Blank Panels

Blank panels are available to cover unused slots on a Primary Hub.

To install blank panels:

1. Place a blank panel over a slot that will not be used and align so that plate hole fits over screw hole at bottom.
   Slots are read by the unit in order in the back from A to D or in the front from 1 to 8. place blank panels on slot numbers after the amount of intended slots are used. For example, if you are using slots 1-4, place blank plates on slots 5 to 8.

2. Insert a retaining screw in the hole and turn to hand-tighten.

5.2 Installing Service Modules in Primary Hub

Service Modules are inserted in the back of a Primary Hub in slots A to D. See "Primary Hub" on page 2-1 for slot descriptions.

⚠️ **Caution:** Optical Module must ONLY be installed on the front panel of a Primary Hub or the unit will not function as expected.

To install Service Modules in the back of a Primary Hub:

Note: If you are adding or updating modules, remove any blanking plates in the rear slots you wish to populate by turning the retaining screw and pulling on the top and bottom of the plate.

1. Visually align the module with the rear slot (screw hole should be on bottom) and insert with your thumbs at the top and bottom of the front of the module.
2. Press the module slightly, until you feel it set against the back of the slot.
   Modules are equipped with floating BMA connectors in the back that are slightly sprung to enhance connectivity.
3. Insert a Retaining Screw and hand-tighten.
   A tightened screw ensures best performance. Performance may degrade if screws are not properly in place.
   If power is applied before insertion, see "Primary Hub and Module LEDs" on page 3-1 for LED descriptions.

Note: LEDs will only fully function when equipment on the other end of the fiber is present and working

5.3 Installing Optical Modules in Primary Hub

Optical Modules are inserted in the front of Primary Hubs. To install Optical Modules:

Note: If you are adding or updating modules, remove any blanking plates in the rear slots you wish to populate by turning the retaining screw and pulling on the top and bottom of the plate.

1. Visually align the module with the rear slot (screw hole should be on bottom) and insert with your thumbs at the top and bottom of the front of the module.
2. Press the module slightly, until you feel it set against the back of the slot.
   Modules are equipped with floating BMA connectors in the back that are slightly sprung to enhance connectivity.
3. Insert a Retaining Screw and hand-tighten.
   A tightened screw ensures best performance. Performance may degrade if screws are not properly in place.
   If power is applied before insertion, see "Hub and Hub Module LEDs" on page 3-1 for LED descriptions.

Note: LEDs will only fully function when equipment on the other end of the fiber is present and working

5.4 Powering the Primary Hub

The Primary Hub has an IEC AC power socket. The cord purchased is country specific.

To Power on the Primary Hub:

1. Make sure the On/Off switch is in the Off (O) position.
2. Plug in the supplied AC power cord the Hub and into an AC power outlet.
3. Move the ON/OFF switch to the On (I) position.
4. Verify LED status shows correct start up sequence and the equipment is ready for operation. See "Start-up Sequence" on page 3-4.

Note if powered up with no modules installed the Primary Hub shows 4 green LEDs. If modules are installed then the alarm warning and fault LEDs may show alarm conditions at initial start-up. This could be due to the fact that no Remote Unit elements are connected. These alarms can be cleared via the Primary Hub Set Up page of the Configuration GUI once the system is correctly configured.

Although modules may be hot swapped, during initial installation it is recommended that the Primary Hub power is switched off until the initial module installation is completed.

Chapter 6: Installing Remote Units

This chapter describes how to install the Remote Units along with their power options.

6.1 Mounting Remote Units

Your system installation plan provides the locations to mount each Remote Unit and their associated antennas. Depending on the available wall space a Remote Unit can be mounted vertically (with antenna connector closest to ceiling) or horizontally (with antenna connectors facing a side wall).

Remote Units are suitable for use in environmental air space in accordance with Section 300-22(c) of the National Electrical Code, and Sections 2-128, 12-010(3) and 12-100 of the Canadian Electrical Code, Part 1, CSA C22.1.

Tools:

- Drill with M4 bit
- Pencil
- M4 Screw driver

Supplied equipment:

- Remote Unit
- Zinwave Patch Cords
- Mounting Bracket
- 4x M4 screws
- RAWL Plugs

Considerations before Mounting:

Installing Remote Units

- The Remote Unit (with mounting bracket) has the following dimensions displayed in millimeters:
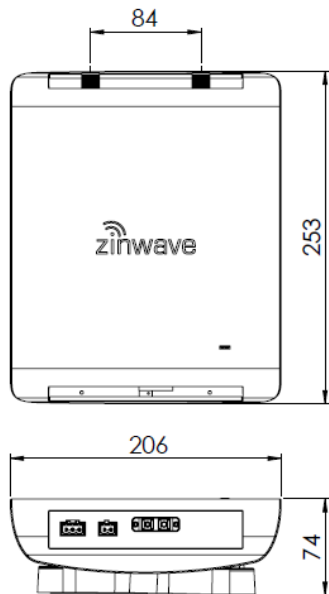
- Ensure that adequate space is provided to allow for any power and signal cables to be connected and that minimum bend radii of cables are met.
- Make sure there is room for antenna connections to exit through the ceiling.
- Make sure there is adequate clearance around the Remote Unit to allow some convection.

The following wall bracket is provided for mounting a Remote Unit:
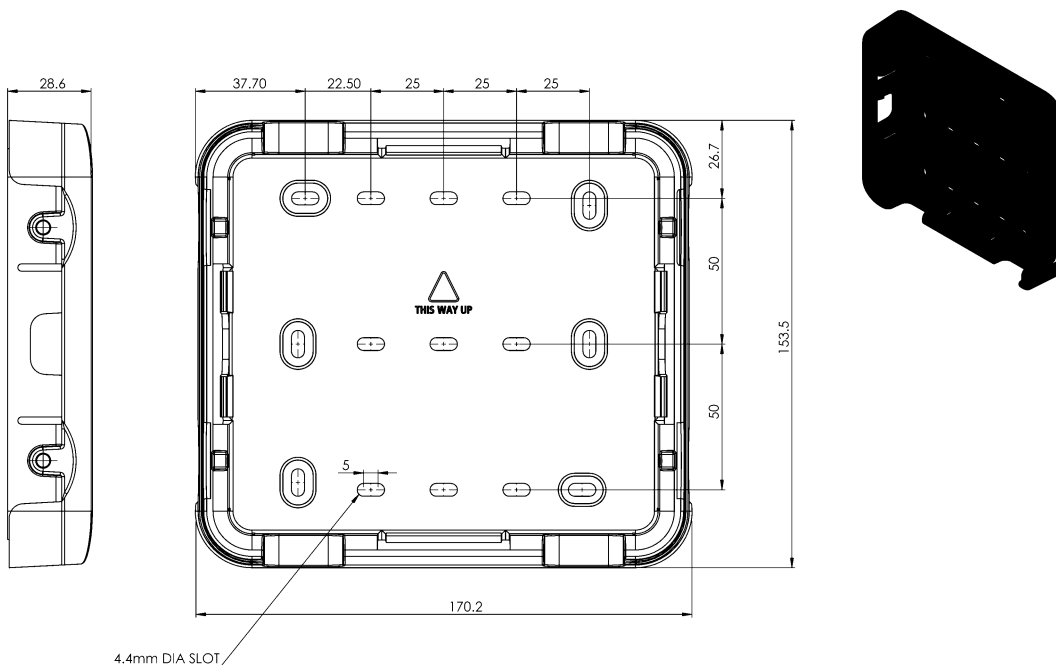
1. Place the mounting bracket on the wall in the desired location and position (Horizontal or Vertical).
2. Select 4 suitable screw holes for attachment, and mark the 4 holes to be used with a pencil. The holes selected should be sufficiently separated. Use one of the 2 hole patterns shown below, or a pattern derived from one of these 2 patterns where each screw may be moved to an adjacent position.

THIS WAY UP

THIS WAY UP
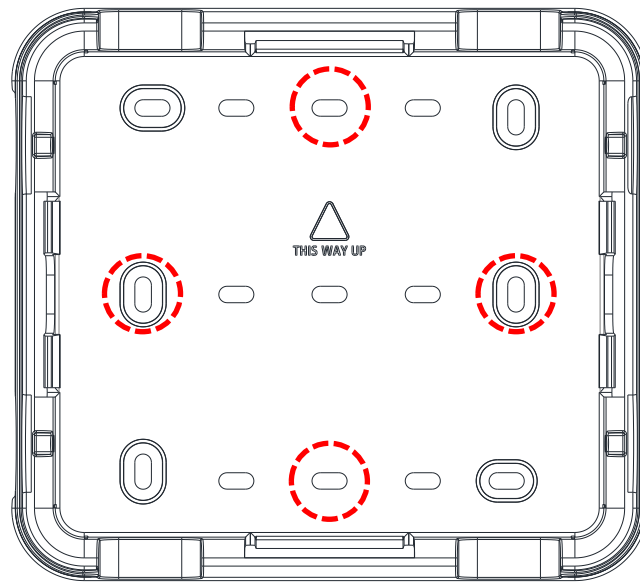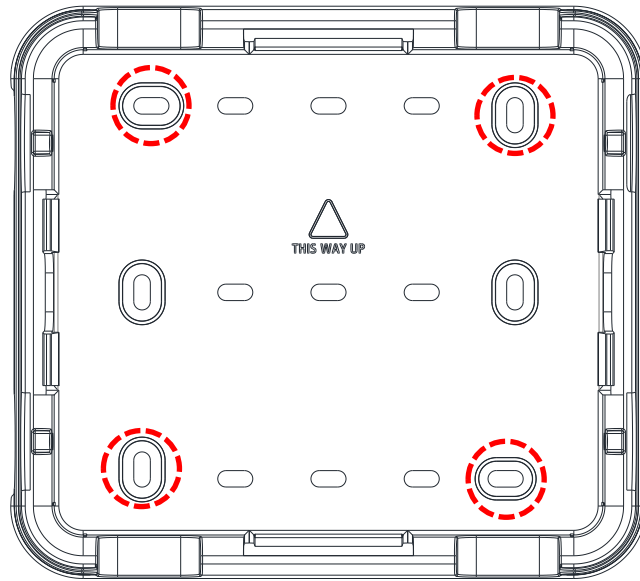
3. Remove the bracket.

4. Drill the 4 screw holes.

5. Attach the bracket to the wall using the a M4 screw driver and the 4x M4 screws.
   You may need to use additional hardware such as rawl plugs, for a secure fit.

6. Ensure the 4 M3 locking bolts are in place on the wall bracket, but not screwed in so far as to protrude into the inner cavity of the wall bracket and prevent the mounting bracket on the Remote Unit from being inserted.

7. Align the plastic mounting bracket attached to the back of the Remote Unit with the wall bracket, and 'plug in' the Remote Unit. The plastic latches should clip in and hold the Remote Unit in place. If the Remote Unit needs to be removed, then hold the Remote Unit on both sides with fingers reaching behind to press the central release buttons on the mounting bracket, allowing the Remote Unit to be 'unplugged'.

8. Once the Remote Unit is 'plugged in', then tighten the 2 M3 locking bolts on each side with a screwdriver to ensure the Remote Unit cannot become detached from the wall mounting. This step is particularly important if the Remote Unit is suspended from the wall bracket and might cause a hazard if it were to become detached.

6.2 Powering Remote Unit

A Remote Unit receives power from a 48V Central PSU (if connected directly to a Primary Hub), or from the Secondary Hub to which it is connected.

6.2.1. PSU DC Power

6.2.2.1. Rack Mount the PSU

The following tools are required for installation (Not provided):

- 4x M6 cage nuts appropriate for 19 inch rack frame (If required)
- M6 pozi-drive screwdriver
- Cage nut insertion/extraction tool
- Washers and Screws, suitable for Rack type, to secure equipment

To install the PSU in a rack:

1. Using the cage/nut insert/extraction tool, install 2 cage nuts on each side of the rack. The spacing needs to align with the holes in the PSU.

2. Place the PSU into the rack and secure using suitable mounting screws and washers.

Installing Remote Units

> **Note:** While a power lead is not supplied inside the box as shipped – Zinwave does provide the country specific power lead in with the shipment where PSU are required by the customer.

6.2.2.2. Applying DC power to the Remote Unit

See "Connecting the PSU to Remote Units" on page 9-2 for pin out information and "Power Distribution Requirements" on page 9-2 for power distribution information.

To connect the PSU to the Remote Unit.

3.   Plug the cable into the appropriate connector on the PSU or Secondary Hub.
4.   Route the cable from the PSU to the Remote Unit.
5.   Plug the cable into the 48V connector on the Remote Unit.
6.   Repeat for each PSU / Secondary Hub to Remote Unit connection. Once power is plugged in, the unit is powered on.

Note: It is recommended to connect fiber prior to powering on the Remote Unit.

Chapter 7: Understanding Antennas

This chapter describes antenna requirements and how to install Antennas.

7.1 Antenna Requirements

This section describes antennas that can be connected to Remote Units. For physical connection of the antenna to the Remote Units see "Connecting Antenna to Remote Units" on page 7-4.

7.1.1. Isolation

The minimum isolation between Tx and Rx required for correct operation of UNItivity 5000 in both the uplink and downlink service bands is usually 40dB (this requirement should be confirmed for any given installation within the Zinwave Coverage Tool). However, performance (uplink noise and downlink inter-mode interference) of the system can be improved if greater isolation is achieved. Isolation between the antennas is achieved by separating them at a sufficient distance to achieve at least 40dB at the lowest frequency service in use.

In addition to the 40dB service isolation described above, a minimum isolation must be achieved within the entire UNItivity 5000 passband according to the graph below:
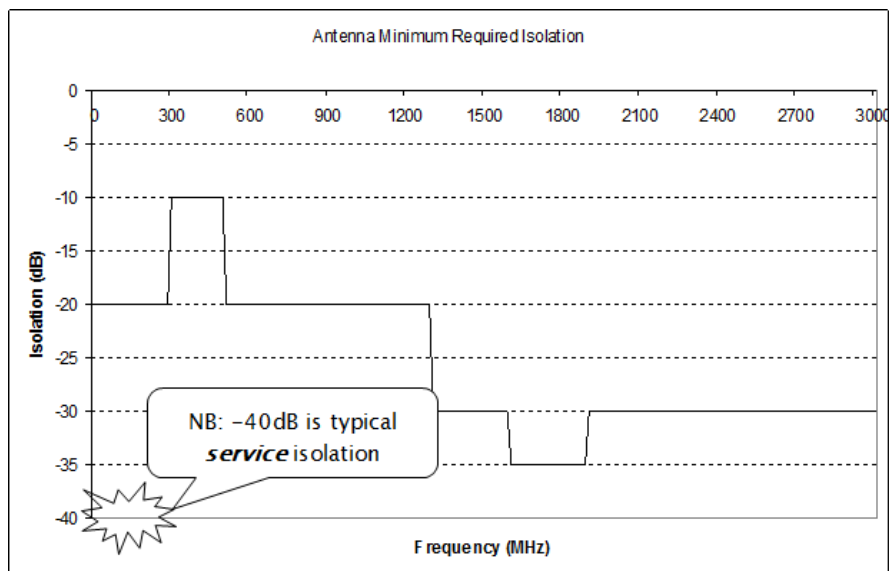
It has been found empirically that omni-directional antennas supporting the Cellular bands from 700MHz and above require a horizontal separation distance of approximately 20 ft (6m). An example of the isolation

that can be achieved using a wideband (LTE, CELL, PCS, AWS) antenna is shown below:

Cellular Specialties CSI-AO/700/2.5k/3
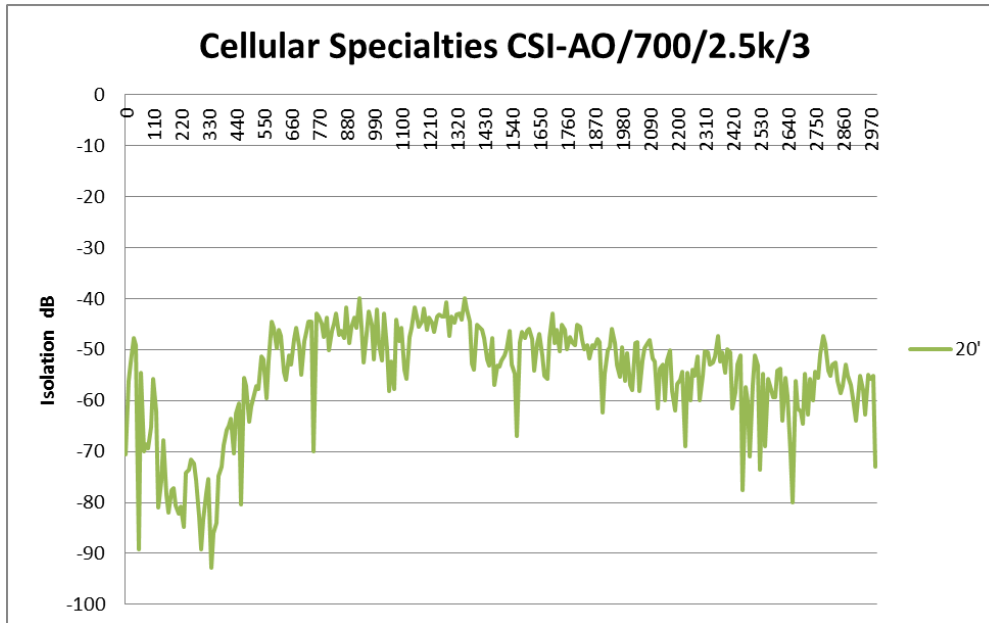
It can be seen that the isolation improves with frequency due to the increasing propagation loss so that the PCS and AWS bands have isolation in excess of 45dB when the CELL band is below 40dB.

Although this distance provides a rule of thumb for initial planning, the particular antennas in use and the environment in which they are installed will affect the isolation. It is recommended to check and measure the isolation of each antenna pair (see isolation measurement section below) prior to enabling service operation.

With directional antennas care should also be taken to ensure the high-gain propagation direction is oriented towards the coverage area and the low-gain ("null") propagation direction is oriented towards the second antenna. The effect of this null will be to reduce the distance between the antennas required to achieve the 40dB isolation.

7.1.2. Isolation Measurement Techniques

The most accurate way of measuring the antenna isolation, is to disconnect the cables at the Remote Unit antenna ports and connect these directly to either a network analyzer or a spectrum analyzer with a tracking generator. Every antenna in the installation should meet the requirements of the Tx-Rx Isolation section above.

Where many antennas within an installation are being checked it is recommended to enter a test mask in the test equipment.

Where it is not possible to access all antennas in this way, it is possible to check the isolation using measurements at the Hub. However, in this case the gain profile of the uplink and downlink paths must be removed from the measured values in order to reveal the actual antenna isolation. It is recommended that a single path is measured with either a known good antenna or a fixed attenuator in order to obtain this "loopback calibration" result. Then all individual antennas can be compared to this known good result to identify problem locations.

An example loopback (downlink+uplink) gain profile is shown in the graph below:
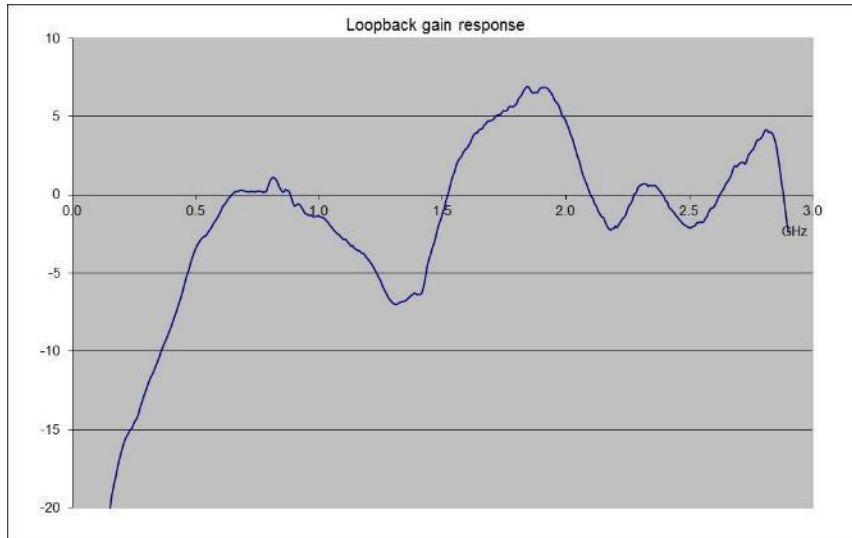
This graph was obtained by injecting a signal into a double-star system with 1 Remote Unit. The Remote Unit had a 50dB attenuator connected between Tx antenna output and Rx antenna input. The test signal was injected into the Service Module input and the resulting signal was measured at the Service Module output. The system settings were set such that the downlink gain was 25dB (nominal) and the uplink gain was also 25dB (nominal). Therefore the nominal loop gain was +25+25-50 = 0dB. The differences from this nominal 0dB that are due to the system gain variation would then have to be subtracted from the gain variations that would be measured if the 50dB attenuator was replaced with an antenna.

It is also possible to measure multiple antennas simultaneously as long as the "combining gain" of multiple antennas is taken into account (approximately 5dB for 8x Remote Unit and 10dB for 64 Remote Unit or more generally 2.4*ln(N) for N* Remote Unit). This method produces a much less accurate result but is a quicker way of verifying a larger number of antennas simultaneously.

7.1.3. Uplink/Downlink Balance

Care should be taken not to separate the two antennas by so much distance that the path difference between Tx and Rx to the mobile affects system performance. Some services are more affected by uplink/downlink path difference than others, especially those using high dynamic range mobile power-control such as WCDMA.

There are two WCDMA system effects to be aware of when testing a separated antenna coverage area:

- When the mobile is close to the Tx antenna but some distance from the Rx antenna, the initial call-setup power that the mobile transmits will be lower than expected by the BTS. It is likely that the BTS will fail to receive the initial call-setup attempt so the mobile will transmit again at a higher power level. The mobile will continue to ramp up its power level until the BTS receives and acknowledges the message. This effect can cause longer initial setup times close to the Tx antenna and in extreme cases may cause the mobile to timeout during call setup. In order to compensate for this effect the balance of gain between uplink and downlink can be adjusted to increase the uplink gain. This is usually done in the head-end by moving attenuation from the uplink to downlink paths. However, in some case the UL/DL balance setting can also be used within the UNItivity 5000 platform if the uplink gain is not already at maximum.
- When the mobile is close to the Rx antenna but some distance from the Tx antenna, the initial call-setup power that the mobile transmits will be higher than expected by the BTS. As long as the mobile power does not overload either the Remote Unit or the BTS input then this should not cause a call setup failure.

Note that the path difference between Tx and Rx at the edge-of-cell is likely to be much smaller than near the antennas due to the effect of the indoor propagation conditions. Where there are no line-of-sight differences between Tx and Rx the edge-of-cell path difference will be less than 3dB for most services.

7.2 Connecting Antenna to Remote Units

The Remote Unit has separate connectors for transmit and receive antennas. The choice of antenna depends on the RF coverage and planned designs for a building, You may need extension cables depending in where the antennas are placed relative the Remote Unit.

To connect antennas to Remote Units:

1. Connect the N-type or Mini-DIN male connections into N-type or Mini-DIN female connectors on the top of Remote Unit Note the markings on the unit for Rx and Tx.
2. If you haven't already done so, feed the RF extension cables through from the Remote Unit to the Antenna.
3. Connect the N-type or Mini-DIN female connections into N-type or Mini-DIN male connectors to the RF tails.
4. Pay attention to the mechanical stress placed on the connector if using large inflexible cable. Use short flexible jumpers where appropriate.

Chapter 8: Infrastructure and Cabling

This chapter provides a general understanding of how the Zinwave equipment fits into your existing or potential infrastructure.

8.1 Understanding Fiber Infrastructure Cabling

Hubs and Remote Units may be separated by a considerable distance. Primary Hubs and Secondary Hubs may also be located far from each other. Fiber cabling is used to connect these components. This connection is referred to as infrastructure cabling. It may form part of the existing structured cabling or could be installed specifically for UNItivity 5000 or be a combination of both. For example, the existing cabling may be used to connect Primary and Secondary Hubs as part of a building backbone while new cabling is run to Remote Unit locations.

Infrastructure cabling is typically terminated on patch panels or small "splice boxes" in the case of Remote Units.

Patch Panel   Termination Splice Box

The infrastructure cable is spliced onto pigtails contained in each termination box to provide a connector interface into which the Zinwave patch cords are plugged. Regardless of the type of patching, the concept is the same. Zinwave patch cords are used to connect to all Zinwave components on one end

and a patch type device on the other. Cabling on the other end of the of the patch device must meet Zinwave specifications. The diagram below shows a conceptual fiber Infrastructure. Note that all connections to Zinwave equipment are now SC/APC.
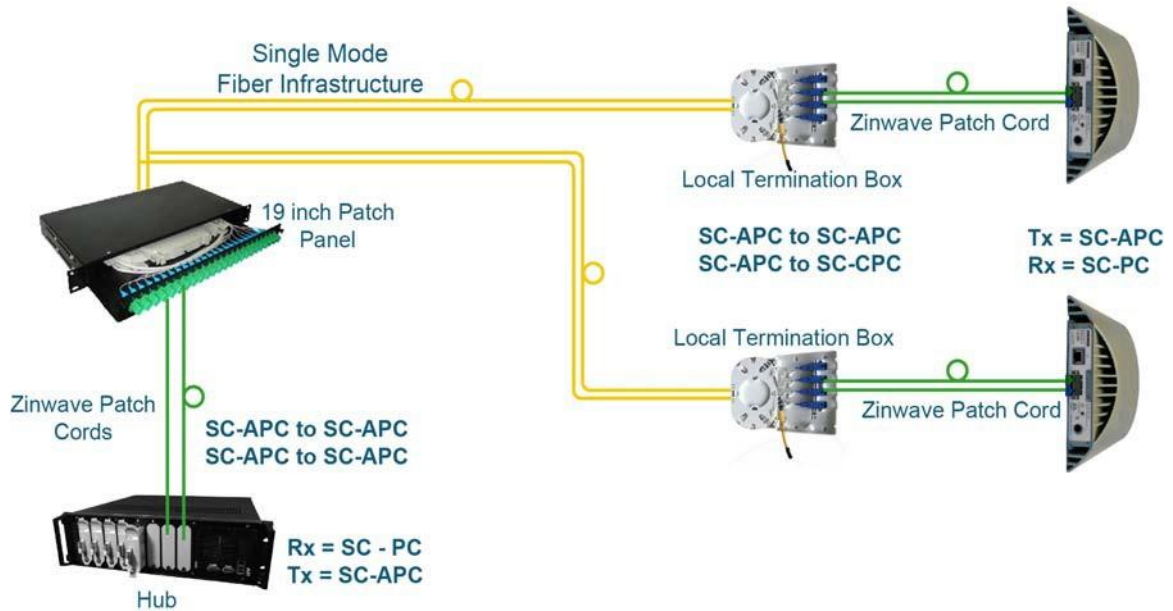
The nature of the infrastructure will depend upon the building type and, if applicable, installed cable.

8.1.1. Selecting an Infrastructure Mode

The UNItivity 5000 system uses a laser in the transmit direction and photodiode in the receive direction, with SC/APC connectors in both directions. The system should be deployed using Singlemode fibre infrastructure.

The interface to infrastructure equipment is typically achieved using Zinwave supplied patch cords. All Zinwave supplied patch cords are provided with the correct duplex SC/APC connectors for the Zinwave equipment, and other optical connectors as specified to match the installed infrastructure.

Any Infrastructure installed between Primary and Secondary and between Secondary and Remote Units must meet the following criteria

- Optical Loss:Less than 5dBo
- Return loss for ALL connections: better than 30dB

Zinwave recommends:

- Singlemode
- APC Connector Type:

⚠ **Caution:** Connector types must match (i.e. SC/APC to SC/APC).

Otherwise, there will be an air gap between the connector faces that will create high back reflection and high optical loss.


8.1.2. Types of Optical Fiber cable

Optical fiber cable is generally available in two types: Singlemode and Multimode.

A UNItivity 5000 system is designed for use with Singlemode fiber and APC connectors. Singlemode optical fiber cables, due to the very small core size (9 µm) transmit a single ray of light while Multimode optical fiber cable, with a larger core size (62.5 µm or 50 µm), carries multiple light rays with different reflection angles within the fiber core. Multimode fibers should not be used with the UNItivity 5000 system.

Single Mode Fiber

Cladding

Core
(so small that only one mode can pass)

Multimode Fiber

Different modes

Cladding

Core
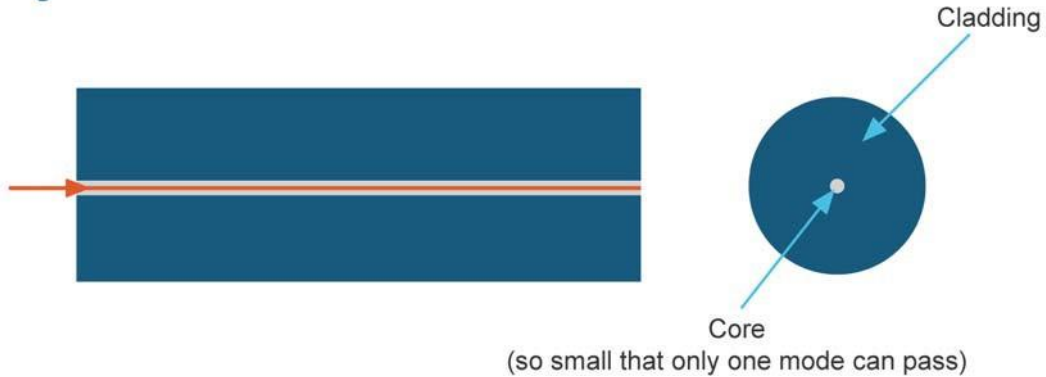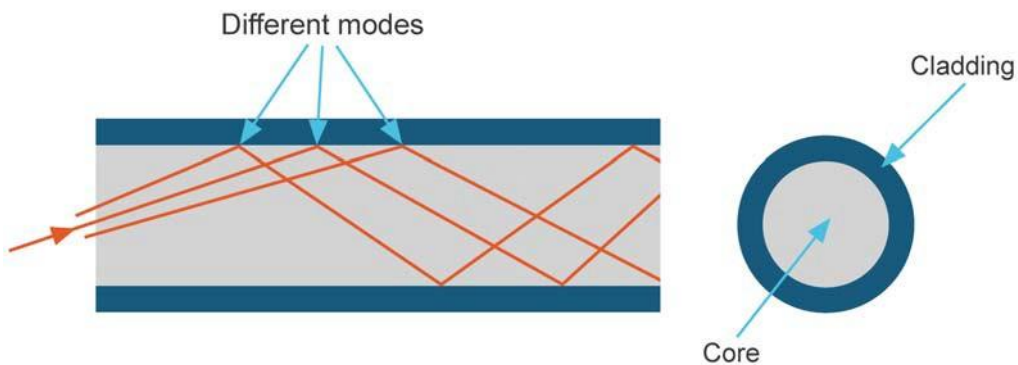
Keeping optical reflections to a minimum is important to achieve good RF performance an RF over fiber DAS system. Single mode fiber is less prone to reflections than multimode fiber. The majority of reflections occur at points of fiber connection within the whole system. This includes Optical Module, Secondary Hub and Remote Unit but more importantly at intermediate connections such as patch panels and fiber splices. Angle polished (APC) connectors should be used throughout to minimize reflections.

Guide to Fiber Colors

Buffer/Jacket Color	Meaning
Yellow	single-mode optical fiber
Orange	62.5 µm multi-mode optical fiber

8.1.3. Infrastructure Interface

The interface used to connect to the Infrastructure will depend upon the connector type preferred or utilized in specific installation scenario.

APC connectors are strongly recommended. Connector types must match (APC to APC and PC to PC) otherwise, there will be an air gap between the connector faces that will create high back reflection and high optical loss. See "Ferrule Types" on page 8-6 for more information on connector types.
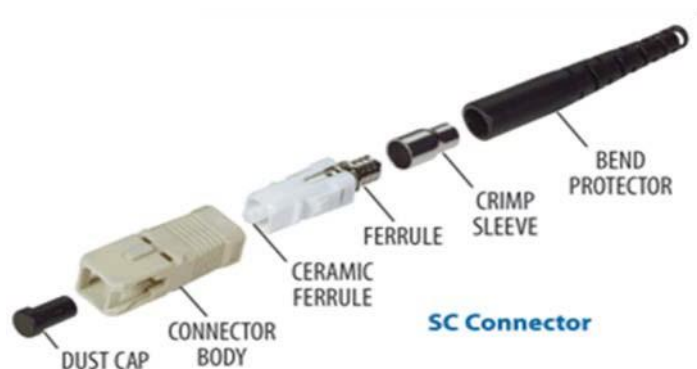
8.2 Fiber Optic Connectors

When connecting to Zinwave Patch Cords care must be taken to ensure that the correct connector and fiber type is provided.

A fiber optic connector consists of two key elements.

- Connector Body Type
- Ferrule Type

There are a wide variety of connector body types used in infrastructure cabling some of the most common types are shown below.

There are two main groupings standard and Small Form factor. The small form factor connectors have a 1.25mm (0.05 in) ferule compared to the ferule size in "standard connectors of 2.5mm (0.1 in).

Zinwave recommends the use of APC connector type.

Type		Description	Cable Type	APC
SC		SC is a snap-in connector that is widely used in Singlemode systems for its excellent performance. It's a snap-in connector that latches with a simple push-pull motion. It is available in both PC, UPC, and APC.	Singlemode and Multimode	Yes
FC		Commonly used in Singlemode networks and is available in PC, UPC and APC variants. It has an outer body that screws in to hold the ferrule firmly in place. It has a key ensuring that the fiber is correctly aligned.	Singlemode and Multimode	Yes
ST		Popular connector for Multimode networks. It has a bayonet mount and a long cylindrical ferrule to hold the fiber. The main body is spring loaded and can cause problems (high loss) if not seated properly.	Singlemode and Multimode	No

| LC | | LC is a newer connector that uses a 1.25 mm ferrule, half the size of the ST. | Singlemode and Multimode | Yes |
| MTR J | | MT-RJ is a duplex connector with both fibers in a single polymer ferrule. It uses pins for alignment and has male and female versions. Multimode only. | Multimode only | No |

8.2.1. Ferrule Types

As shown above some of these connectors can be designated either APC or PC, this refers to the Ferrule within the connector body. The TIA 568 color code for connector bodies and/or boots is:

Green	Singlemode APC (angled) connectors	
Blue	Singlemode (UPC)	
Beige	Multimode	

Attaching a connector to an optical fiber cable will cause some of the light traversing that optical fiber to be lost. Regardless of whether the connector was installed in the factory or the field, its presence will be responsible for some light being reflected back towards its source, the laser. This is known as return loss (RL) and high levels of unwanted reflections can degrade the signal's performance.

The amount of optical return loss generated is related to the type of polish that is used on the connector. There are three basic types of polish:

- APC
- UPC
- PC

8.2.1.1. APC (Angled Physical Contact)

The "angled physical contact" (APC) connector is best as it offers the lowest return loss characteristics of connectors currently available. In an APC connector, the end face of a termination is polished precisely at an 8-degree angle to the fiber cladding so that most RL is reflected into the cladding where it cannot interfere with the laser source.
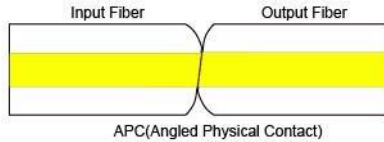
As a result, APC connectors offer a superior RL performance with atypical back reflection of better than 60dB.

8.2.1.2. UPC (Ultra-polished Physical Contact)

Typical Back Reflection: <-35dB for Singlemode fiber

UPC connectors are very similar to PC connectors in that the ferrules faces are flats but have a much better return loss, which can be better than 50 dB. This performance is due to an improved polishing technique applied to the face and to the curvature at the ferrule end. The rounded finish created during the polishing process allows fibers to touch on a highpoint near the fiber core where light travels UPC polish is available for almost all Singlemode connectors--namely FC, SC, ST, but, unlike PC connectors, is not available for Multimode fibers.
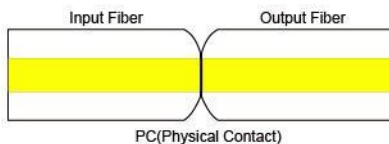
When using UPC connectors it is essential to confirm optical back-reflection levels using an OTDR as described in the sections below.

8.2.1.3. PC (Physical Contact)

Typical Back Reflection: <-35dB for Singlemode fiber

The "physical contact" (PC) connector is probably the most common type of ferrule face. It is available on both Singlemode and Multimode fibers but due to the flat face has reduced return loss and is more prone to dirt and poor connections.
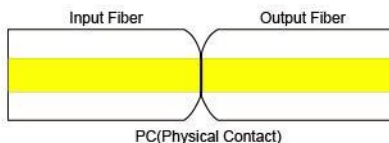
When using PC connectors it is essential to confirm optical back-reflection levels using an OTDR as described in the sections below.

> **Note:** UPC can be mated to PC connectors as both have flat faces but APC connectors can only be connected to APC connectors due to the face angle.

8.3 Handling Optical Fiber

Follow the recommendations listed in this section when handling Optical Fiber.

Observe minimum bend radius (typical 30mm):

- Alters guiding properties of fiber introduces loss
- Often reversible, but non-reversible defects hard to detect

Ensure good connections:

- Especially with pluggable connectors (SC, LC)
- Risk of latching only one of the connectors in duplex configuration

Keep connectors clean:

- Always use the provided dust caps until connection is made
- Dirty connectors introduce loss and reflections
- Dirt can also cause defect on connector facet
- Clean connectors with alcohol-saturated wipes and lint-free tissues

Don't mix different fiber types

- Insertion loss from MMF $\rightarrow$ SMF is >20dB

8.4 Diagnosing Fiber connections

To diagnose fiber connections see "Performing Diagnostics and Testing" on page 17-1.

8.5 Link Calibration

The system performs gain self-calibration when a link is established using internally generated signals and measurement circuits. The self-calibration is designed to optimize the system gain settings for the required downlink output power and to minimize uplink noise figure for the required maximum input signal.

Part of the self-calibration includes compensation for installed cable and connection losses. Measurements are made in both the optical and RF domains.

Chapter 9: Making Connections

This chapter provides a general understanding of how to connect equipment within the system.

9.1 Connecting Service Modules to RF inputs or POI

⚠️ **Warning:** If the service module is connected directly to the output of a BTS or any RF input source, maximum power delivered to a service module must not exceed 15dBm. Use additional equipment to attenuate the power.

You can connect Service Module inputs (e.g. BTS, via a POI) only to the Primary Hub.

To connect into the Service Module:

1. Connect the N-type male connections into N-type female connectors on the Service modules inserted in the rear of the Primary Hub.
2. Pay attention to the mechanical stress placed on the connector if using large inflexible cable. Use short flexible jumpers where appropriate.

9.2 Optical Connections

Whether connecting an Optical Module to the fiber infrastructure, a Secondary Hub or a Remote Unit, you will typically terminate the connection to the Zinwave hardware using a Zinwave optical patch cord..

When installing any fiber, pay careful attention to cleanliness and good installation practice.

The following instructions describe how to connect to Zinwave optical interfaces.

9.2.1. Connecting Optical Modules to Infrastructure or Secondary Hubs

To connect Optical Modules (installed in a Primary Hub) to infrastructure or Secondary Hubs:

1. Remove the protectors from the SC/APC connectors on the Optical Module and the patch cord.
2. Plug the duplex SC/APC Green connector into an Optical Module (note: on Optical Module or Secondary Hub, the INput port is at the top, and the OUTput port is at bottom).
3. Repeat the above steps for the other end of the optical patch cord. Whether it is connected to an optical patch panel or a Secondary Hub, make sure to abide by the recommendations in "Understanding Fiber Infrastructure Cabling" in section 8-1.

Important: It is very important that only Green duplex SC/APC connectors are inserted into the SC/APC connectors on the Zinwave UNItivity 5000 hardware. The installer needs to ensure that the OUT port from the Optical Module or Secondary Hub is connected to the IN port on the Remote Unit, and vice-versa. If Zinwave hardware is connected directly using Zinwave optical patch cords, the keying of the duplex SC/APC connectors on each end will ensure that these connections are correct.

Making Connections

9.2.2. Connecting Optical Modules or Secondary Hubs to Remote Units

To connect Optical modules or Secondary Hubs to Remote Units:

1. For Remote Units, install fiber optic cable of sufficient length to reach the Remote Unit, noting the need for the Zinwave patch at the each end.
2. Remove the protectors from the SC/APC connectors on the Optical Module and the patch cord.
3. Plug the duplex SC/APC Green connector into an Optical Module (note: on Optical Module or Secondary Hub, the INput port is at the top, and the OUTput port is at bottom).
4. Remove the protectors from the SC/APC connectors on the Remote Unit and the patch cord.
5. Insert the duplex SC/APC Green connector into the Remote Unit (note: on Remote Unit, the INput port is at the right, and the OUTput port is at the left.

Important: It is very important that only Green duplex SC/APC connectors are inserted into the SC/APC connectors on the Zinwave UNItivity 5000 hardware. The installer needs to ensure that the OUT port from the Optical Module or Secondary Hub is connected to the IN port on the Remote Unit, and vice-versa. If Zinwave hardware is connected directly using Zinwave optical patch cords, the keying of the duplex SC/APC connectors on each end will ensure that these connections are correct.

9.3 Connecting the PSU or Secondary Hub to Remote Units

9.3.1. Power Distribution Requirements

Power for Remote Units is generally supplied from a centrally located source – either a dedicated PSU or a Secondary Hub - that drives multiple Remote Units. The distance of the Remote from the centralized location depends upon the cable type used. Regardless of the cable used, the maximum loop resistance should generally be kept below 8 ohms to ensure the minimum input voltage requirement of the Remote Unit is not violated.

Copper wire containing 2 cores is typically used to carry 48V power to Remote Units. This can either be run in parallel with fiber infrastructure, or as part of a composite cable.

With AWG 22, the maximum distance that can be achieved is approximately 300 m (~1000 ft). If greater distances are required, larger gauge cable may be used. The Phoenix Contact connectors used on the Zinwave equipment support wire thickness up to AWG 12. The table below provides typical cables distances against AWG.

Cable Type	AWG	Conductor Diameter (in)	Conductor Diameter (mm)	Individual Conductor Area (mm²)	Total Conductor (mm²)	Nominal Loop Resistance Ω	Remote Unit Distance (m)	Remote Unit Distance (ft)
Single Pair of Conductors	12	0.0808	2.05	3.31	3.31	8	789	2589
Single Pair of Conductors	13	0.072	1.83	2.63	2.63	8	627	2058
Single Pair of Conductors	14	0.0641	1.63	2.08	2.08	8	496	1628

Cable Type	AWG	Conductor Diameter (in)	Conductor Diameter (mm)	Individual Conductor Area (mm²)	Total Conductor (mm²)	Nominal Loop Resistance Ω	Remote Unit Distance (m)	Remote Unit Distance (ft)
Single Pair of Conductors	15	0.0571	1.45	1.65	1.65	8	393	1290
Single Pair of Conductors	16	0.0508	1.29	1.31	1.31	8	312	1024
Single Pair of Conductors	17	0.0453	1.15	1.04	1.04	8	248	814
Single Pair of Conductors	18	0.0403	1.02	0.82	0.82	8	196	644
Single Pair of Conductors	19	0.0359	0.91	0.65	0.65	8	155	509
Single Pair of Conductors	20	0.032	0.812	0.518	0.518	8	124	407
Single Pair of Conductors	21	0.0285	0.723	0.41	0.41	8	98	322
CAT 6 (4 pairs)	22	0.0253	0.644	0.326	1.304	8	311	1021
CAT 6 (4 pairs)	23	0.0226	0.573	0.258	1.032	8	246	808
CAT5 (4pairs)|CAT 6 (4 pairs)	24	0.0201	0.511	0.205	0.82	8	196	644
CAT 5 (4 pairs)	25	0.0179	0.455	0.162	0.648	8	155	509
CAT 5 (4 pairs)	26	0.0159	0.405	0.129	0.516	8	123	404

9.3.2. Understanding the Connectors & Cabling

Cabling between the PSU or Secondary Hub is not supplied. ~~You will typically use a 2 core cable.~~

Ensure that the 48 V cable used is one of the following:
  i.   2-core power cable listed in accordance with NEC 645.5(B)
  ii.   **Or** Installed in an enclosed raceway
  iii. **Or** be installed in accordance with NEC 721.135(C)
  iv.   **Or** be type CMP< CMR, CN or CMG
  v.   **Or** be listed type DP cable suitable for use under raised floors

Termination of each cable type will depend on the PSU version used, and you may need to utilize an adapter to make the final connection. Ensure the 48V connection is made with correct polarity.

Note: If you use your own 48V power supply, rather than the Zinwave Remote PSU or Secondary Hub, the cable instructions are the same as for the Zinwave equipment

The 48V power connector used on the Zinwave Secondary Hub and Remote Unit is:

TERMINAL BLOCK HDR 2POS 5.08MM	PHOENIX CONTACT	P/N: 1757242

Pin	Detail
Left	48V (+)
Right	0V (-)

~~A suitable mating~~ Mating ~~socket~~ plugs from the same series of connector ~~should be used~~ are provided and should be used to terminate the 2-core cable.

The 1U Rack-mount PSU uses screw terminals, so the wire pair may be connected directly in that case.

9.4 Connecting the PSU to a Primary Hub

You can control and monitor the Rack-Mount PSU using the Primary Hub GUI. For this operation, a physical connection must be made between the PSU and the Primary Hub.

To physically connect a PSU to a Primary Hub:

1. Using a USB (Type A) to USB (Type B) connector, insert the Type B end into the PSU connector slot on the PSU.
2. Insert the Type A end into the USB connector slot on the Primary Hub.
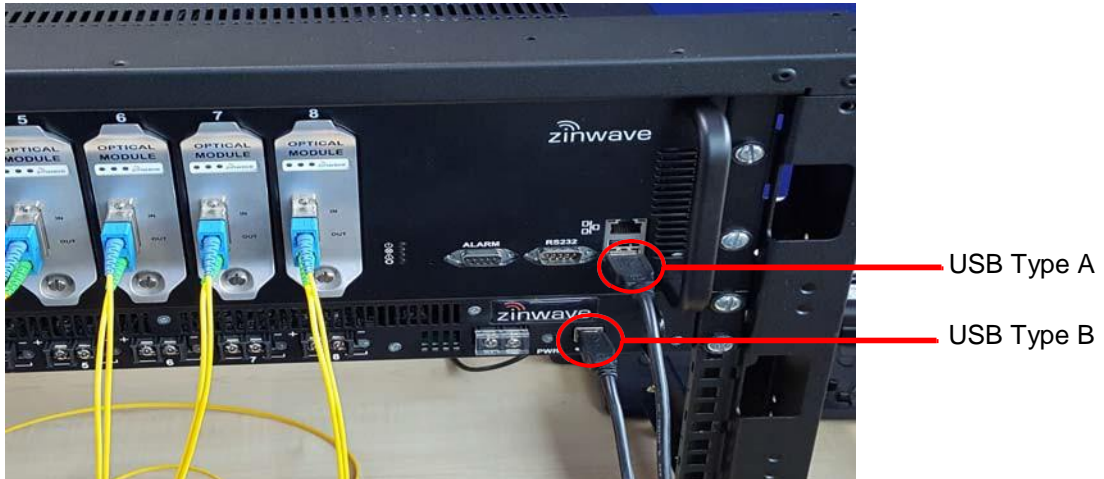
3. The PSU will be detected and can be monitored via the Configuration GUI. See "PSU Setup" on page 12-10 for details.

9.5   Grounding Rack Mounted Equipment

The Hubs, PSU, and POI are rack mounted. Each has an M3 threaded Grounding Post that should be connected via Bonding Cable (12 AWG) to the Grounding Bus Bar in the rack. the Rack itself is also grounded via an M5 post.

Rack Elevation
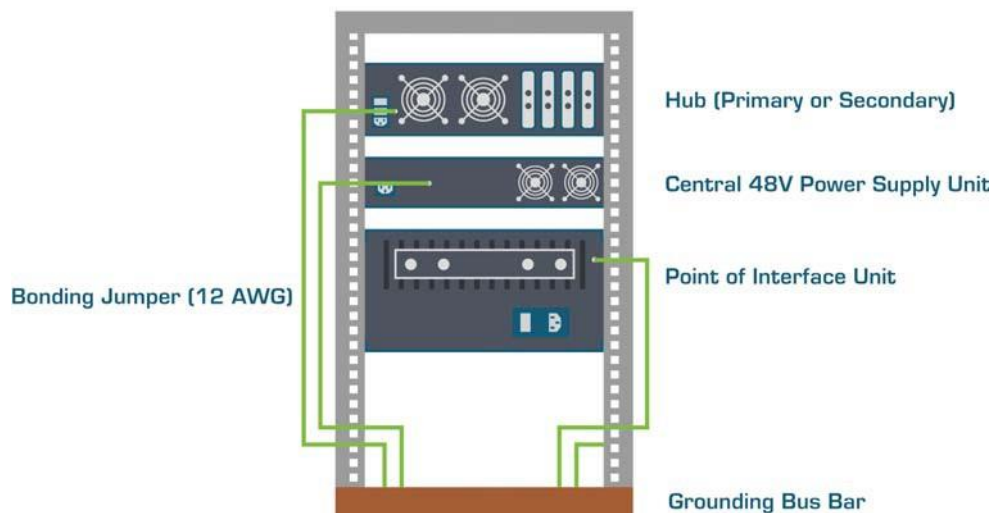
To ground the equipment:

1. Using bonding cable with solid green outer sheath, connect the grounding post of each unit to the rack grounding bus bar.
2. Attach the bonding cable using a retaining washer and ring terminal to each grounding post.

Note: Bonding cable should be 18 AWG minimum with 12 AWG recommended.

Making Connections

Chapter 10: Performing Basic Configuration

The following procedures are intended to be executed after the hardware installation is complete. All hardware has been installed and configured with at least an IP address. All equipment is connected and the system is ready to be configured. See "Performing a Basic Installation" on page 4-1 for a guide to basic installation.

To Configure UNItivity 5000 after basic installation:

1. Gather all needed input information such as measured signal input powers including any allowance for pilot back off and relative power levels generated by the coverage tool.
    This will provide you the following information:
    *   Input power from each Service
    *   Service mix and allocation to Remote Units
    *   Composite power settings
    *   Results of any coverage calculations for each Remote Unit
2. Access the GUI and configure the Hub type for each Hub. See "Accessing the GUI" on page 11-1 and "Setting the Hub Type" on page 12-1.
3. Make sure power is on for every unit. See "Powering the Hub" on page 5-5 and "Powering Remote Unit" on page 6-3.
4. Make sure all modules have been inserted. See "Installing and Populating Hubs" on page 5-1.
5. Make sure all connections have been made. Power and data and all units are on. Self discovery happens and LEDs are green. See "Start-up Sequence" on page 3-4.
Note: Indicator lights will adjusts as system setup configuration is corrected.
6. Login to the Primary Hub. See "Accessing the GUI" on page 11-1.
7. Set date and time on Primary Hub in Hub setup. See "Setting Hub Date and Time" on page 12-7. This will propagate to all other Hubs.
8. On the Primary Hub check and, if necessary, upgrade to the latest software version. See "Update Firmware" on page 12-1.
9. Enter the System Setup information supplied to you for all Hubs and Remotes. See "Understanding System Setup" on page 14-1.
10. Review system status and RU calculations. See "Understanding System Status" on page 13-1.
11. Enter sensitivity and alarms. See "Service Module Downlink Sensitivity" on page 15-8, "RU Uplink Sensitivity" on page 15-5, and "Understanding Alarms and Reporting" on page 16-1.
12. Enter LAN setup, if desired. See "LAN Settings for Hubs" on page 12-8.
13. Save config file and save system layout. See "View System Layout" on page 13-8 and "Configuration Files" on page 15-1.

Chapter 11: Understanding the Configuration GUI

A Configuration Graphical User Interface (GUI) is available to configure your equipment locally or remotely via ethernet. The GUI is hosted on the Primary Hub, and is used to configure and monitor the Primary Hub and all connected Secondary Hubs and Remote Units. This section describes how to access the GUI and the general features of this interface. Specific configuration items are located in their respective sections.

Screen captures in this manual are shown using the Chrome browser. Windows may appear slightly different based on your browser; however, features are the same.

11.1 Supported Browsers

The Configuration GUI is web-based application. It runs on a variety of browsers including: Windows Explorer, Mozilla Firefox, Google Chrome, and Safari.

11.2 Initial Stand-alone Access

In order to access the GUI from a stand-alone PC via direct ethernet connection, you need to match the PC's IP address to the same subnet as the default Primary Hub address.

To change the IP address of the standalone PC:

1. Set the standalone PC's IP address to192.168.0.1 (the default Primary Hub IP address is 192.168.0.2)
2. Make an Ethernet connection from the standalone PC to the Primary Hub (either a crossover or straight-through Ethernet cable can be used).
3. Connect one end of the Ethernet cable to the network port on the front of the Primary Hub.
4. Connect the other end of the Ethernet cable to the standalone PC.
5. Access the GUI as described in "Accessing the GUI" on page 11-1 and go to the Hub Setup page to change the IP address. See "LAN Settings for Hubs" on page 12-8.

11.3 Accessing the GUI

The GUI is accessible via Web browser through a secure connection (https). For initial configuration of a device, you need local access via ethernet to the front of the Primary Hub. After that, you can access the Hubs and Remote Units remotely on the network you created during the initial setup. Every Primary Hub is delivered with the same default IP address https://192.168.0.2.

To access the GUI:

1. Open the desired browser.
2. In the address line, enter **https://**ip_address.
   where the ip_address is the address of the device you wish to configure. For an initial configuration the IP address is 192.168.0.2. If you changed it in "LAN Settings for Hubs" on page 12-8, use that address.

3. Press **Enter**.
    A Security Certificate authorization may appear depending on if the PC you are using to access the device has previously been used. If it appears go to step 5. If not the Login window appears, go to step 5.

4. Accept the Security Certificate.
    Depending on your browser, a series of acceptances may available to accept the security certificate. Click through the options to accept the Certificate. You may need to select advanced options to see all acceptance options.
    The Login window appears.

5. Enter the username and password. There are three privileges levels available.

Username	Default Password	Description
viewer		View system status but cannot make any changes.
basic	installer	View system status and can make only a subset of configuration changes.
advanced	supervisor	View and change all options.

See "Changing User Passwords and Timeouts" on page 11-5 for information on changing passwords.

The table below iterates specific items available to a Basic user.

Feature	Section	Permission
Event Log	USB Event Log	Start and stop USB Event logging.
Hub Setup	Date and Time	Can change only the current time and date settings in this section.
Hub Setup	Alarm Handling	Can change only the severity of a warning (Amber or Green) for Warning LEDs.
Hub Setup	Alarm Handling	Can clear any warning relay or fault relay which has triggered in the system.

Feature	Section	Permission
Hub Setup	Security Settings	Can change only the Basic level of password.
Hub Setup	Security Settings	Can change the inactivity timeout value, but cannot set to keep logged in.

6. Click **Log In**.

    On successful login, the System Status window appears. The left navigation menu allows access to all other screens in the application. See "Left-Navigation Area" on page 11-4.

11.4 Understanding the Main Window

Once logged in, the Main Window is displayed. Depending on the browser used, the look and feel may differ slightly, but the functionality remains the same. The GUI opens to the System Status page by default and displays the Hub to which the PC is connected.
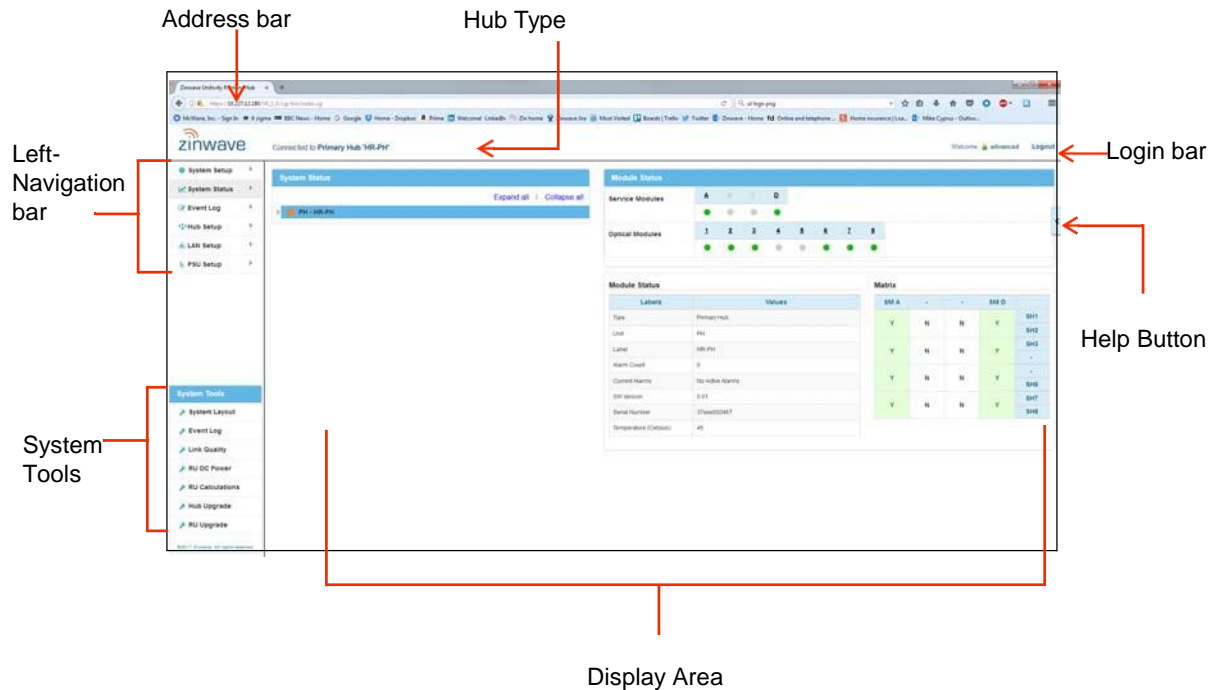
11.4.1. Address Bar

The address bar displays the IP address of the Hub you are currently logged into. It also shows the version of the software installed on the Hub.

IP Address   Current Version
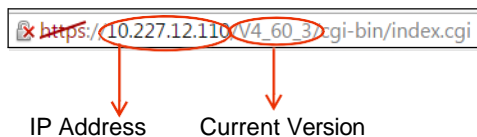
11.4.2. Left-Navigation Area

The Left-Navigation area displays the top-level functions for the system.

11.4.3. Login Bar

The login bar shows you who is logged into this application.

11.4.4. Help Button

The Help Button is available on the right-side of the screen.

To access help:

1. Click the arrow Help button on the right side of the screen.
    The help window opens with help specific to your current screen.
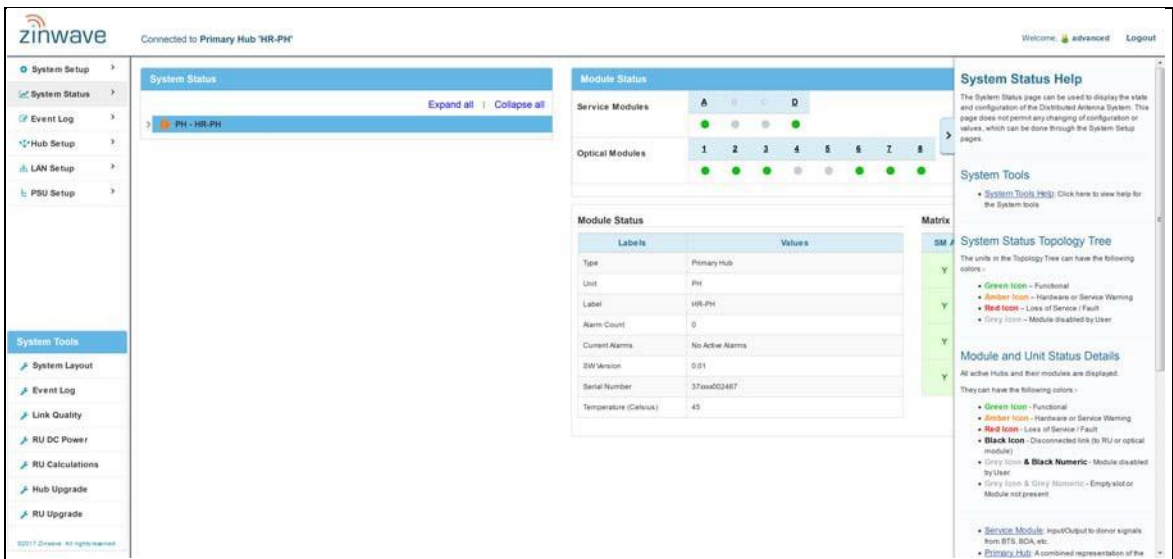
2. View the help and click through to get to additional information, if desired.

11.4.5. Display Area

The Display area shows the items clicked in the left-navigation bar or with the current screen.

11.4.6. Progress Indicator

 Throughout the use of the application, the progress indicator is displayed. This indicates that the system is gathering or calculating information. When the task is complete, the desired information or page is displayed.

11.5 Changing User Passwords and Timeouts

As an Advanced user, you can change the password and inactivity logout for users on a particular Hub.

To change User Security settings for a Hub:

1. Click **Hub Setup** in the left navigation bar.
   The Current user is shown in the Security Settings pane.
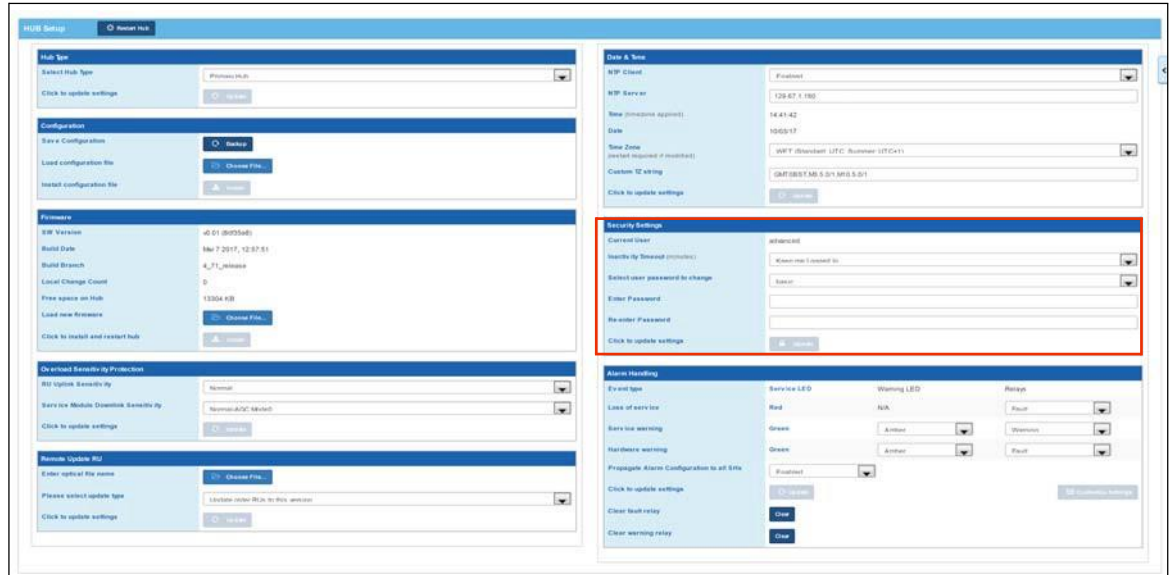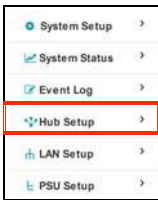
2. Select the desired amount of minutes from the Inactivity Timeouts pulldown in the Security Settings pane to allow inactivity in the Configuration GUI before forcing a logout.
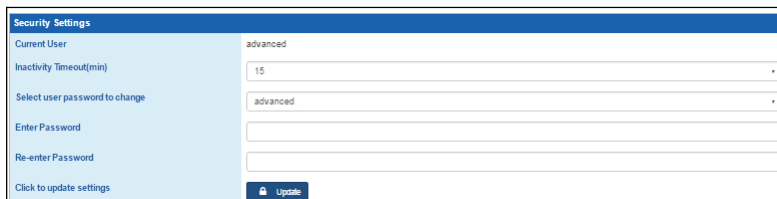
Advanced users can also choose to be kept logged in.

3. Select the user type password to change from the pulldown.
4. Enter a new password
5. Re-enter the new password.
6. Click **Update**.

Chapter 12: Initial System Setup

This chapter provides the basic configuration setup items to get a system up and running.

Note: If you wish to setup SNMP during the initial setup of the system, see "SNMP" on page 16-10.

12.1 Connection to DAS System

The entire DAS system is setup and configured via the Primary Hub.

Access the GUI on your Primary Hub using a Web Browser, as described in Section 11.

12.2 Update Software

Equipment is shipped with the latest version of software at the time of manufacture; however, updates may have been made after shipping. The latest version of software is always available via your Zinwave supplier or from the support area on our website www.zinwave.com (Registration is required). A UNItivity 5000 software update will update the Primary Hub software, as well as firmware on connected Secondary Hubs and Remote Units.

12.2.1. Full System Software Upgrade

You can update firmware for all system elements remotely via the Configuration GUI. This feature updates Primary Hub and all connected Secondary Hubs and Remote Units. The update file must be accessible through the software (either locally, on the network, or via USB). You can download the software from zinwave.com.

To update all hubs:
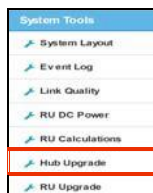
1. Click **Hub Upgrade** from the System Tools menu.
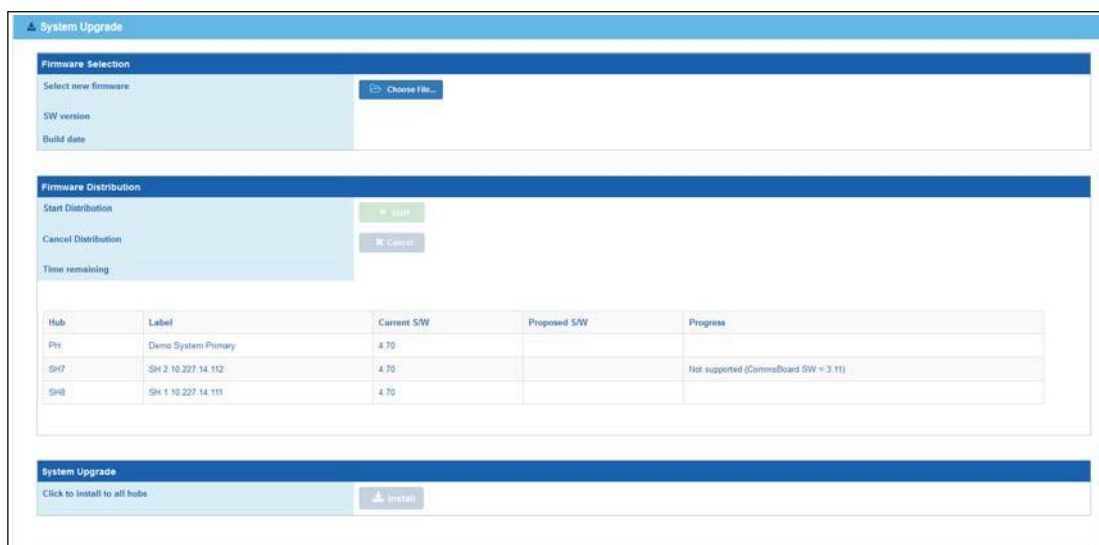
2. Click **Choose File** and navigate to the desire file.
   The system indicates that it is updating.
   After seeing the upload successful message, the Start button is activated.
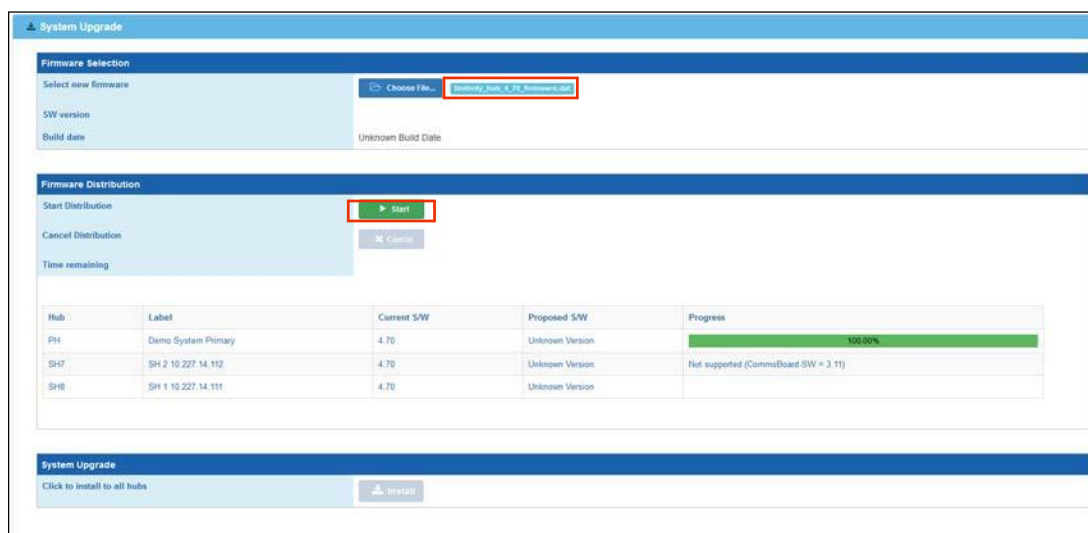
3. Click **Start** to distribute the upgrade files to all of the elements in the system.
   This may take some as indicated on screen. A Cancel button is available. Cancelling the activity loses all progress made up to that point. The status of each file transfer is displayed and after completion, the Install button is activated.

Initial System Setup

4. Click **Install**.
    The update is installed on all Hubs and Remote Units (as required) and all system elements re-start
    and execute the newly installed firmware.

12.3 Setting Primary Hub Date and Time

You can set the date and time used for logging events and other data on the Primary Hub. You can choose to use NTP or to manually enter Data and time information.

1. Click **Hub Setup** in the left navigation bar.
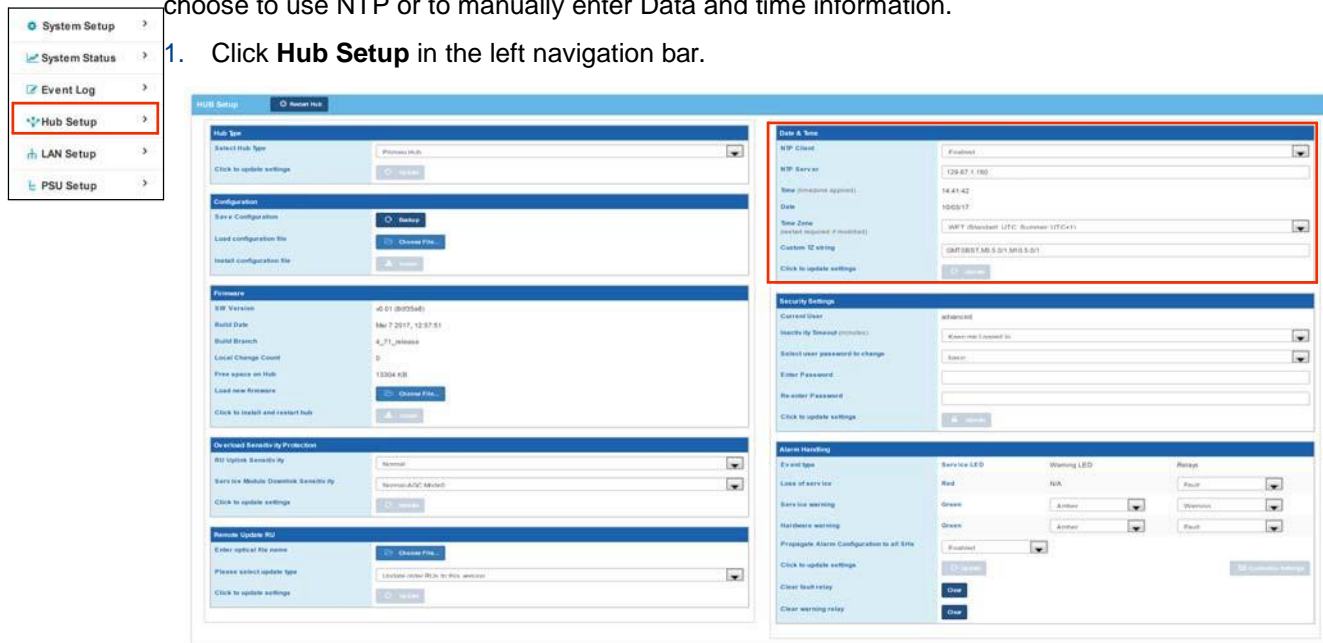
2. Select the desired NTP information or manual entry information.

Type	Description
NTP Client	Enable or disable the NTP client. If enabled. Enter an NTP server IP address.
NTP Server	Enter the IP address of the NTP server, if enabled.
Time	Enter a manual time using the pulldowns. Not needed if using NTP.
Date	Enter a manual date using the pulldowns. Not needed if using NTP.
Time Zone	Select the desired timezone from the pulldown. A Hub restart is required if selected.
Custom TZ String	Enter a free text custom time zone string, if desired.

3. Click **Update**.
   The Hub reboots. You need to log back in to make any additional configuration changes.

12.4 User Interface Settings

By default the system uses the standard security technology Transport Layer Security (TLS) for establishing an encrypted link between a Hub and the browser. This link ensures that all data passed between the web server and browsers remain private and integral. This is indicated by HTTPS. You can opt out of the secure connection by changing this setting.

Important: You cannot update Firmware with a non-secure (http) connection. Make sure your connection is https prior to attempting to upgrade firmware.

To change connection settings:

1. Click **LAN Setup** in the left navigation bar.
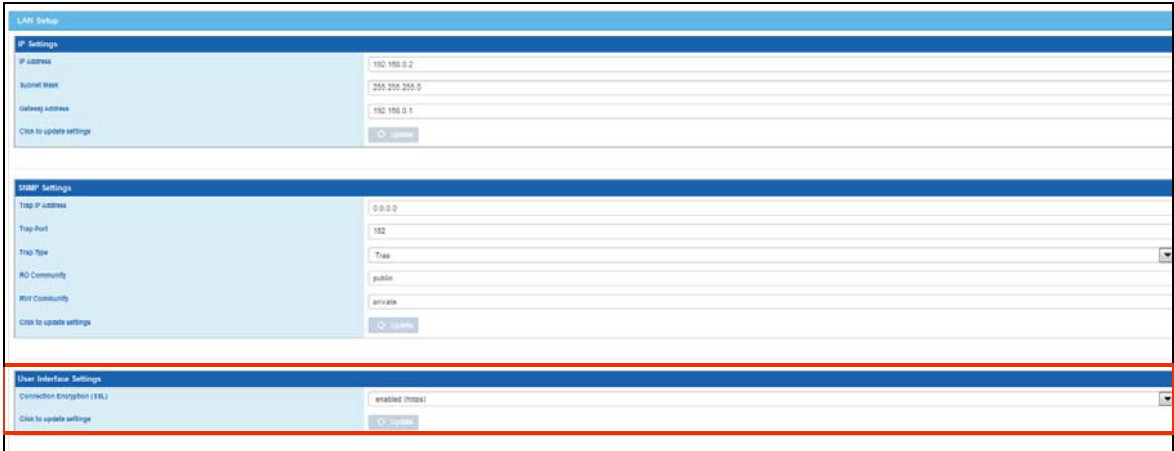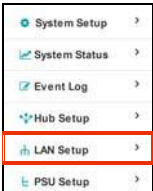
2. Select the desired option from the pulldown in the User Interface Settings Pane.
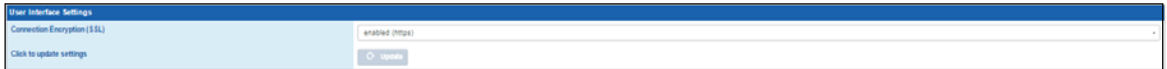
   Enable (https) to keep a secure connection or disabled (http) to have an unsecured connection.

3. Click **Update**.
   After the address is changed, you are logged out and the system reflects the new address in the address bar.

4. Log back into the system.

12.5 LAN Settings for Hubs

12.5.1. IP Settings

IP settings are used when you first install a Hub and whenever you want to change an IP address.

To change an IP address for a Hub:

1. Make an Ethernet connection directly from a PC to the Hub via the Ethernet port on the front of the Hub.

2. Click **LAN Setup** in the left navigation bar.
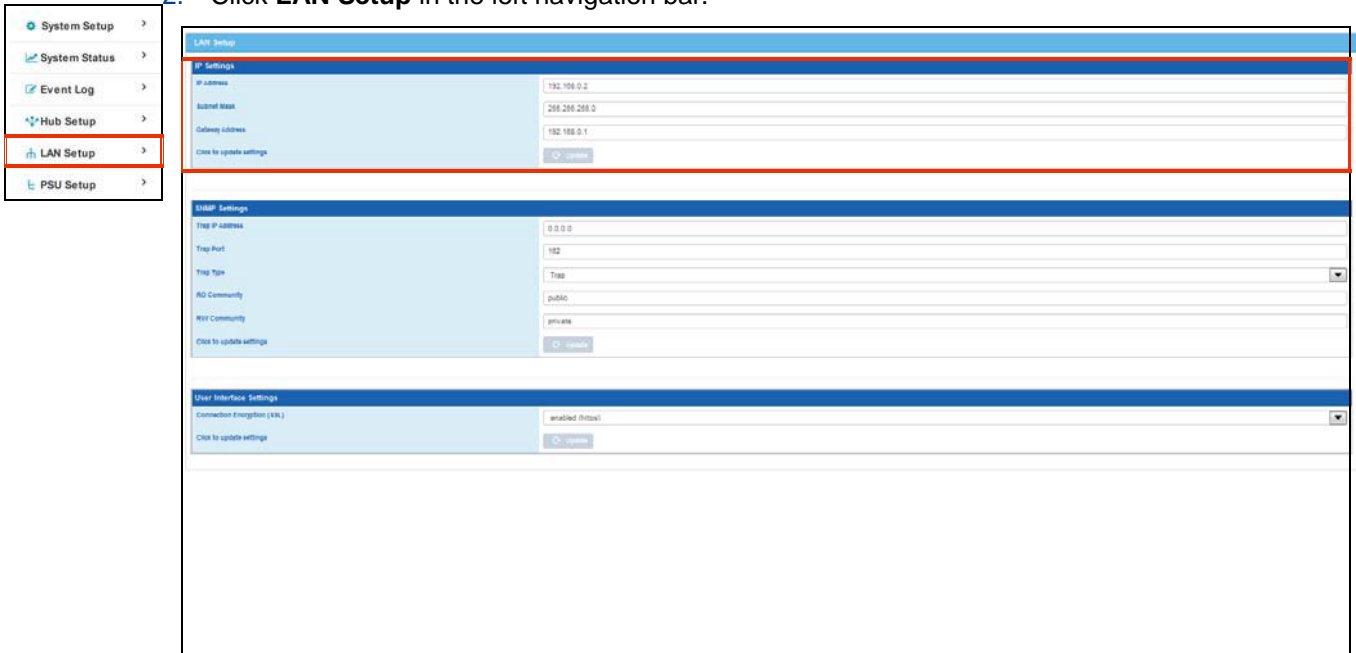
3. Enter the desired IPv4 Address, Subnet Mask, and Gateway Address in the IP Settings pane.
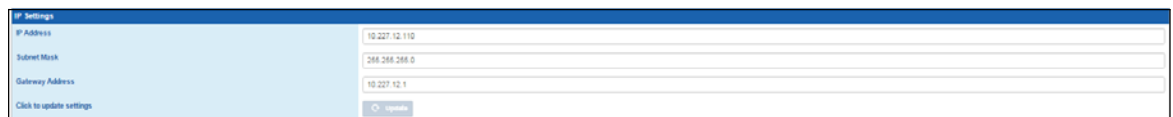
Important: If Hubs are all on the same network, make sure address of individual Hubs are not duplicated.

4. Click **Update**.
   After the address is changed access will be lost to the Hub, you must log back into the Hub with its new address to continue configure. If the IP address is being changed from the network rather than directly connected to the hub, the new address is populated for you.

5. Reconfigure your PC network settings in order to access the Hub.

6. Log back into the system.

12.6 PSU Setup

After the PSU is physically connected to a hub (see "Connecting the PSU to a Hub" on page 9-4), as an Advanced user you can turn PSU ports on and off via the software.

To perform PSU setup:
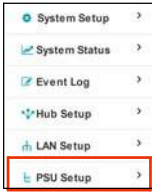
1. Click **PSU Setup** from left navigation menu.

System Setup	>
System Status	>
Event Log	>
Hub Setup	>
LAN Setup	>
PSU Setup	>

PSU Setup

PH-PSU

☑ Edit   ⚙ Restart

Serial Number: 170101000832

Firmware version: 1.0

EEPROM Settings: Disabled

Ports	1	2	3	4	5	6	7	8
Status	●	●	●	●	●	●	●	●
Current (A)	0.33	0.28	0.32	0.52	0.56	0.28	0.64	0.25
Voltage (V)	47.66	47.6	47.63	47.53	47.53	47.47	47.47	47.53
Alarms	0	0	0	0	0	0	0	0

2. Click **Edit**.

PH-PSU

☑ Edit   ⚙ Restart

Serial Number: 170101000832

Firmware version: 1.0

EEPROM Settings: Disabled ▼

Ports	1	2	3	4	5	6	7	8
Status	✓	✓	✓	✓	✓	✓	✓	✓
Current (A)	0.32	0.28	0.32	0.52	0.56	0.28	0.64	0.25
Voltage (V)	47.66	47.6	47.64	47.53	47.53	47.47	47.47	47.52
Alarms	0	0	0	0	0	0	0	0

↻ Update   Cancel

The PSU settings are now editable.

3. Select the desired EEPROM settings.

   EEPROM Settings is disabled by default. Enabling will store the current status of the PSU in memory and, in the event of a power cycle, the PSU will power on in that same configuration.

4. Check or unckeck the port checkbox to enable or disable the port.

5. Click **Update**.

   Enabled ports have a green LED on the equipment and are shown similarly on screen; Disabled port LEDs are not illuminated on the equipment and are gray on screen.

PH-PSU								
						☑ Edit	⚙ Restart	
Serial Number:		170101001216						
Firmware version:		1.0						
EEPROM Settings:		Disabled						
Ports	1	2	3	4	5	6	7	8
Status	●	●	●	●	●	●	●	●
Current (A)	0.55	0.64	0.04	0	0	0	0	0
Voltage (V)	48.76	48.82	48.94	49.07	0	0	0	0
Alarms	0	0	0	0	0	0	0	0

Chapter 13: Understanding System Status

The System Status window is displayed when you first log into the Configuration GUI on a Hub and when you request it. It provides an overview status of all installed Hubs and Remote Units. This view-only page provides a tree status of each device and its installed components and connections.

13.1 Viewing System Status

You can view system status when you first log into the Configuration GUI or when you request it via the left-navigation menu. When viewed from the Primary Hub, the status displays all of the connections from the Primary Hub through its Secondary Hubs and Remotes. When viewed from a Secondary Hub, all of the connections to that Hub are shown. The Primary is not shown in this case.

To view system status:
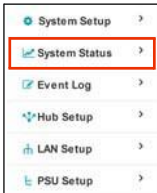
1. Click **System Status** in the left-navigation menu.
   The System status window is shown.

2. Click the Primary Hub (PH).
   Primary Hub Module Status panes are displayed to the right.

3. Click the arrow next to the Primary Hub in the System Status pane.
   This expands the tree to show details about the Primary Hub and then Secondary Hubs (SH) and Remote Units (RU) or any Remote Units connected directly to the Primary Hub.
   For the Primary Hub Service and Optical Module status panes are displayed to the right, while Remote Units and Secondary Hubs are shown in the tree.

4. Click the desired item in the tree.
   When you click a Secondary Hub, module status is displayed on the right in a similar fashion to the Primary Hub.
   When you click a Remote Unit, details about the interface and status are displayed. Similarly, clicking on the arrow to the left of the SH will expand the tree further and show Remote Units connected to the Secondary Hub.

Understanding System Status

Expanding all Secondary Hubs will then provide a simple tree view of the entire system.
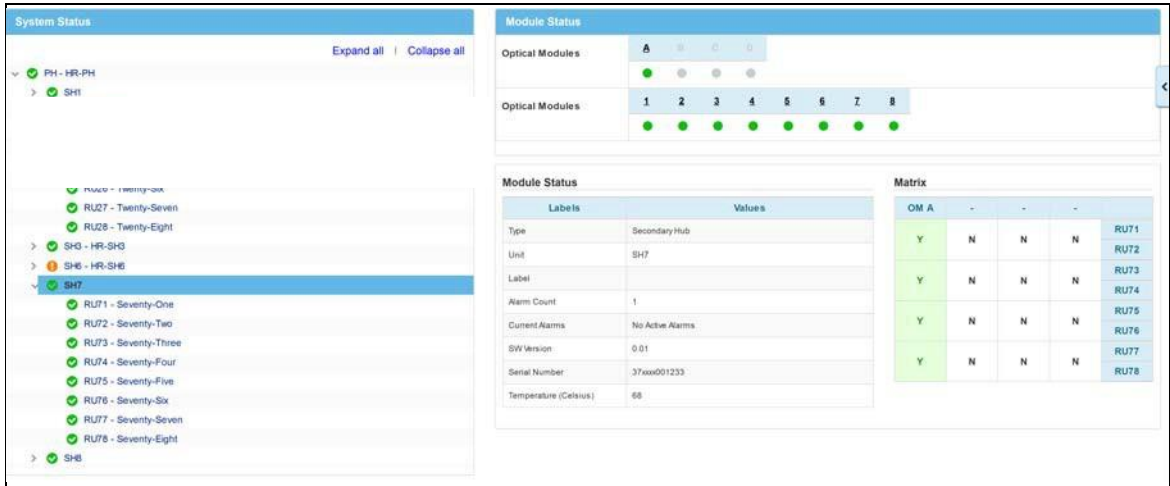
For additional System-level status information. See "View System Layout" on page 13-8 and Download the event log.

13.2 Interpreting System Status

System status is displayed in an expandable and collapsible tree. Colors and symbols are used to show status. Any alarms are shown at a higher level if the tree is not fully expanded. For example, if there is a fault on the Remote Unit, it is shown on the Remote Unit when the Remote Unit is visible. If the Remote Unit is concealed, due to a collapsed view, then the Secondary Hub shows the alarm. Similarly, if the Secondary Hub is concealed the Primary Hub shows the alarm. In some cases viewing the system setup shows that there are issues in the system that need to be addressed and fixed prior to making the system operational. On occasion, a new issue is indicated in this view, alerting that a problem needs to be corrected.
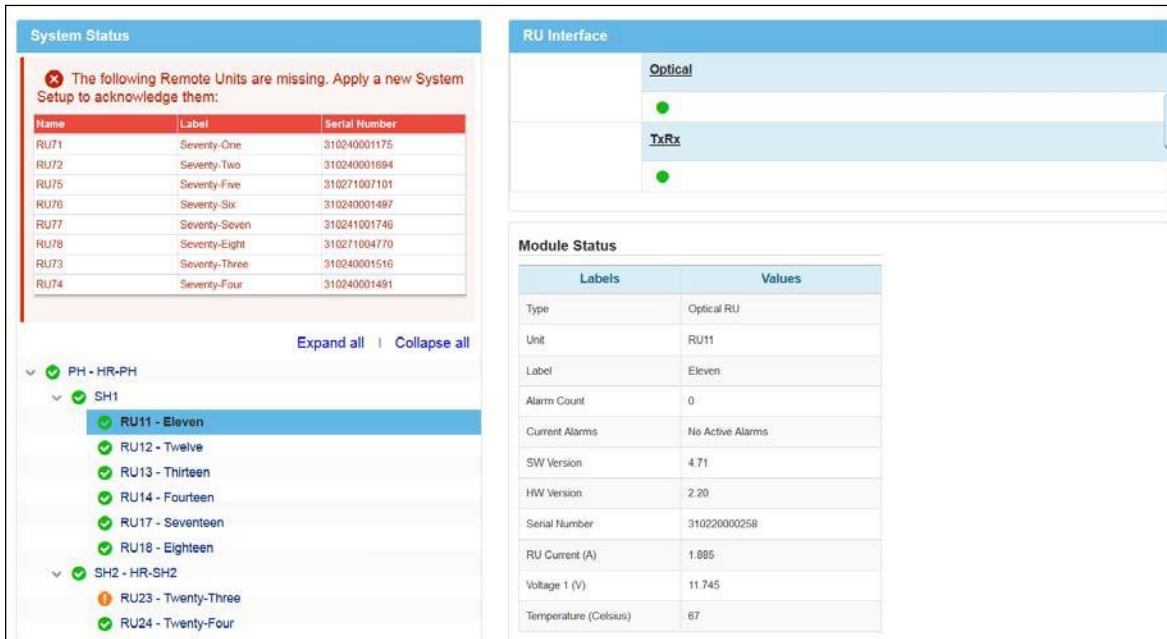
13.2.1. Colors and Symbols

Items are displayed throughout the system status screens with color coding and symbology to indicate status

System Status Topology tree.

Status	Color/Symbol text	Symbol
Good	Green/Checkmark	
Trouble	Red/X	
Warning	Amber/Exclamation point	
Disable by user	Grey dot	

Text colors used for Module/Remote Status:

Status	DOT Color/ Symbol Text	Symbol
Module installed and operational	Green/Black Text underlined	
Hardware or service warning	Amber/Black Text underlined	
Loss of service/fault	Red/Black Text underlined	
Disconnected link (to Remote Unit or Optical Module)	Black/Black Text underlined	
Module Installed but disabled (via System Setup)	Grey/Black Text underlined	
Module not installed in the slot	Grey/Grey Text	

13.2.2. Hub Status

Both the Primary and Secondary Hubs, provide details about the modules they have installed and the Matrix of signal routing that has been configured.

Module status is displayed for Service and Optical modules where applicable. Slots A to D in the rear and 1 to 8 in the front are shown with color coding to indicate module status. Signals are routed from the Rear to the front. N indicates signal routing along that path. Y indicates that path is active and the color coding indicates the status of the path.

Understanding System Status

Module Status details are listed in the on-screen table and described here.

Label	Value Description
Type	The type of unit being viewed.
Unit	The ID of the Unit.
Label	The label of the unit, if entered in System Setup.
Alarm Count	Numbers of alarms on the Hub since the Hub was last power cycled or reset.
Current Alarms	Details about current alarms.
SW version	The current version of the software.
Serial Number	The serial number of the unit.
Temperature (Celsius)	Internal temperature of the unit

13.2.3. Remote Unit Status

When you click Remote Unit in the tree, the status of the Optical and RF interfaces are shown, along with further details in the table below.

To view Remote Unit Status

1. Click the Remote unit in the navigation tree.
   The status of the Optical and RF interfaces are shown, along with further details in the table below.
2. Click either the desired Optical Interface or the Desired Tx/Rx interface.
   The information displayed in the table below is customized to your selection.

When no interfaces are selected, the following table is displayed:

Label	Value Description
Type	The type of unit being viewed.
Unit	The ID of the Unit
Label	The label of the unit, if entered in System Setup.
Alarm Count	Numbers of alarms on the Hub since the Hub was last power cycled or reset.
Current Alarms	Details about current alarms.
SW version	The current version of the software.
Serial Number	The serial number of the unit.
HW version	The current version of the hardware.
Temperature (Celsius)	Internal temperature of the unit.
RU Current (A)	The Current within the optic part of the Remote Unit.
Voltage 1(V)	The Voltage within the optic part of the Remote Unit.

Understanding System Status

When Optical interfaces are selected, the following table is displayed:

Label	Value Description
Type	The type of unit being viewed.
Unit	The ID of the Unit
Module State	Enabled or Disabled
Alarm Count	Numbers of alarms on the Hub since the Hub was last power cycled or reset.
Current Alarms	Details about current alarms.
Comms	Communication active.
Uplink Optical Power	Uplink power measured in uW.
Temperature (Celsius)	Internal temperature of the unit.
Downlink Optical Power	Downlink power measured in uW.
Uplink CAL	Uplink calibration measured in dB.
Downlink CAL	Downlink calibration measured in dB.
Recalibration	Statement that recommends recalibration if needed.

When TxRx interfaces are selected, the following table is displayed:

Label	Value Description
Type	The type of unit being viewed.
Unit	The ID of the Unit.
Module State	Enabled or Disabled.
Alarm Count	Numbers of alarms on the Hub since the Hub was last power cycled or reset.
Uplink RF Power	Uplink RF power measured in dBm.

For additional Remote Unit Power information, see "View Remote Unit DC Power" on page 13-10.

For Additional Uplink and Downlink link quality gain and loss information, see "View Link Quality For Remote Units" on page 13-10. The optical performance of all links ares shown in System Tools section under Link quality.

13.3 System Tools

The System Tools pane is available on the left side of the application. The tools provide additional status information for the System as a whole and for Remote Units. System Tools may open in an additional window or tab, depending on your browser setup. System Layout and Event Log tools are the minimum set of information you should capture when contacting Zinwave support regarding a problem.

For information about Hub Upgrade and Remote Upgrade System Tools, see "Update Firmware" on page 12-1.

Understanding System Status

13.3.1. View System Layout
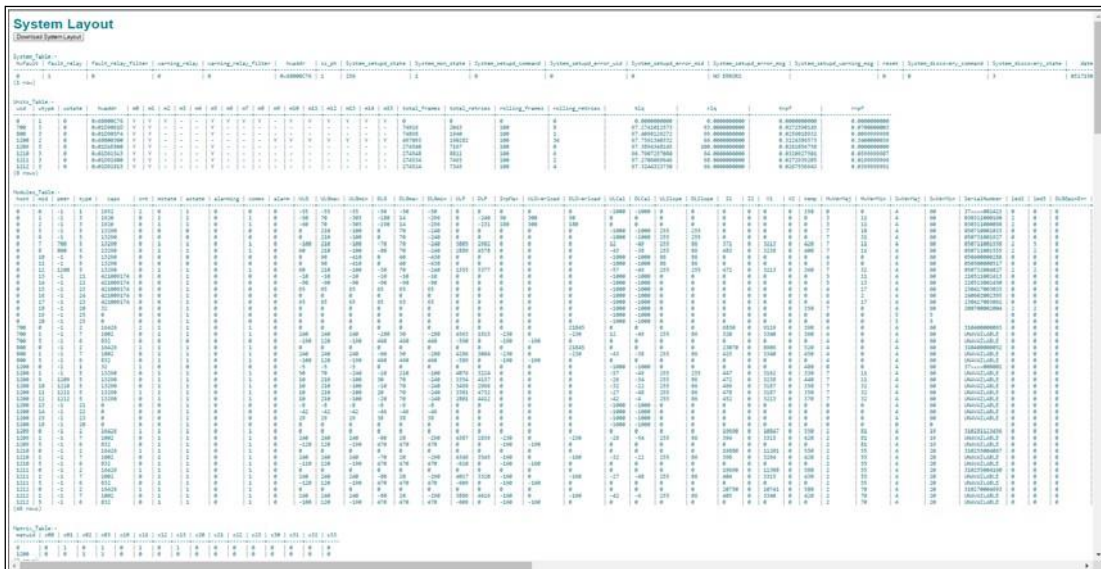
You can view a complete and detailed system configuration table of system layout status. Depending on the complexity of your system, this could be quite a bit of information. You can download the table to a file and then view it other formats, such as an Excel Worksheet.

When selected from a Primary Hub, all the Hubs Secondary Hubs and Remote Units (even those on Secondary Hubs a) in the installed system are shown. When selected on a Secondary Hub, only the units attached to that Secondary Hub are shown.

To View System Layout:
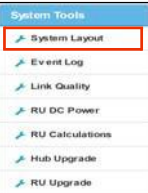
1. Click **System Layout** in the System Tools menu.
   The System Layout window appears.

2. Scroll to view the table as desired.
3. If desired, click **Download System Layout** to save the table to a file.

The file is saved to the default location for your browser. For example, Chrome save is to the Downloads folder.
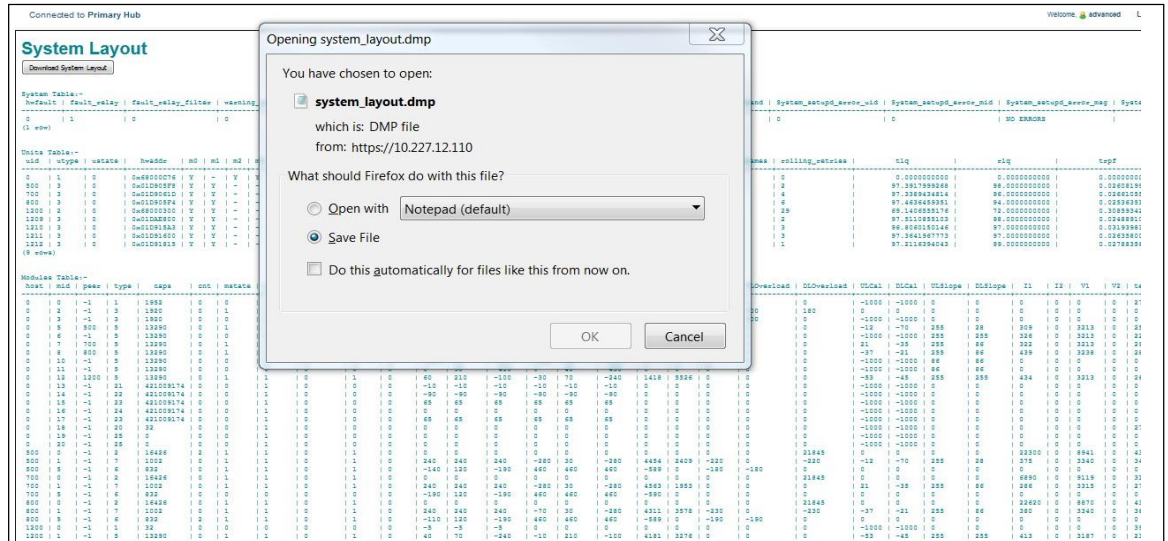
The file has a .dmp extensions which Windows may not recognize. You can open the file in a text editor. See "Interpreting System Layout Tables" on page 17-5 for how to interpret this file. If requesting help from Zinwave, please have this file up and ready to discuss and/or sent to Zinwave.

The output can be converted using the latest version of the system layout tool. (SystemLayout_Gen.xlsm). This file is available on the delivered USB drive and from zinwave.com.

Note: Using earlier versions may result in occasional spurious layout issues. The latest version is supplied with the software.

13.3.2. View Event Log
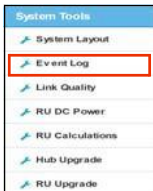
The Log file contains the last 200 events on the system. Depending on the complexity of your system, this could be quite a bit of information. You can download the table to a file and then view it other formats, such as a text editor or Word document. See "Event Log" on page 17-3 for information on the system events.

13.3.3. View Link Quality For Remote Units

You can view the Uplink and Downlink link quality gain and loss for Each Remote Unit.

To view link quality:
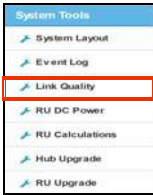
1. Click **Link Quality** in the System Tools menu.
   The Link Quality window appears.

Link Quality

Unit #	Label	Uplink		Downlink	
		Optical Loss(dBo)	Calibration Value(dB)	Optical Loss(dBo)	Calibration Value(dB)
RU03		0	1.2	0	-4.9
RU04		0	-4.3	0	-3.8
SH8		0	-5.7	0	-4.9
RU85		0	-2.6	0	-5.4
RU86		0	-3.2	-0.73	-2.2
RU87		0	-2.7	0	-4.8
RU88		0	-4.2	-0.19	-0.4

‹ Back to Module Status

The gain and loss based on the information in System Setup is shown. The values displayed in the table are the measured optical and RF losses which are used to calibrate the system. These values are used along with set up information to automatically set correct system values when Apply is pressed in Edit System Setup.

2. View the desired values.
   Any values which are close to or exceeded the limits of fiber loss are highlighted so that poor optical links are easily identified. see "Understanding Poor Optical Links" on page 14-4 for more information.

13.3.4. View Remote Unit DC Power

You can view the details about Remote Units' DC Power Consumption. If viewed from the Primary Hub all DC values are shown. If viewed from a Secondary Hub only the DC values of Remotes connected to the Hub are shown.

To view RU DC Power:
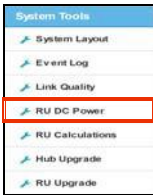
1. Click **RU DC Power** in the System Tools menu.
   The RU DC Power window appears.

Remote Unit DC Power Table

Unit #	Label	Remote Unit Supply Data		
		Input Voltage (V)	Input Current (A)	Input Power (W)
RU03		9.12	0.70	6.40
RU04		8.91	2.31	20.55
RU85		10.85	1.97	21.31
RU86		11.20	1.99	22.30
RU87		11.31	1.97	22.27
RU88		10.74	2.07	22.26

‹ Back to Module

The Input voltages and current are displayed for each Remote Unit along with the overall power consumption for each Remote Unit.

2. View the desired values.

13.3.5. RU Calculations

The RU Calculations window shows Hub input setup values and for each Remote Unit shows output power, uplink input power and the gain applied for each system carried by that Remote unit. This data is also available from the System Layout Tool (Autosetup tab when exported). See "View System Layout" on page 13-8 for more information.

To view RU calculations:

1. Click **RU Calculations** in the System Tools menu.
    The RU calculations window appears.

Chapter 14: Understanding System Setup

System Setup provides a baseline for the configured system that is used to set up internal gain stages, taking into account all fiber connections and self-calibration data.

System Setup is available on a Primary Hub. It is not available on a Secondary Hub. You can configure all Hubs and Remote Units from this window. The system takes all measure internal values such as optical loss, together with additional data you input and sets up the system. This additional information is obtained from RF input measurements and from information calculated using the Coverage Tool.

The base line is used to show any changes that may occur within the system. Addition or removal of elements can only be confirmed by Applying changes made after editing System Setup.

System Setup consists of two major steps:

1. Manage individual links within the system by reviewing current System Setup and System Status Windows. See "Understanding System Status" on page 13-1 for System Status window description and "Managing Links by Viewing Status" on page 14-2.
2. Input System Values. See "Inputting System Values" on page 14-5.

An overview flow diagram of the System setup process is shown here.

Understanding System Setup
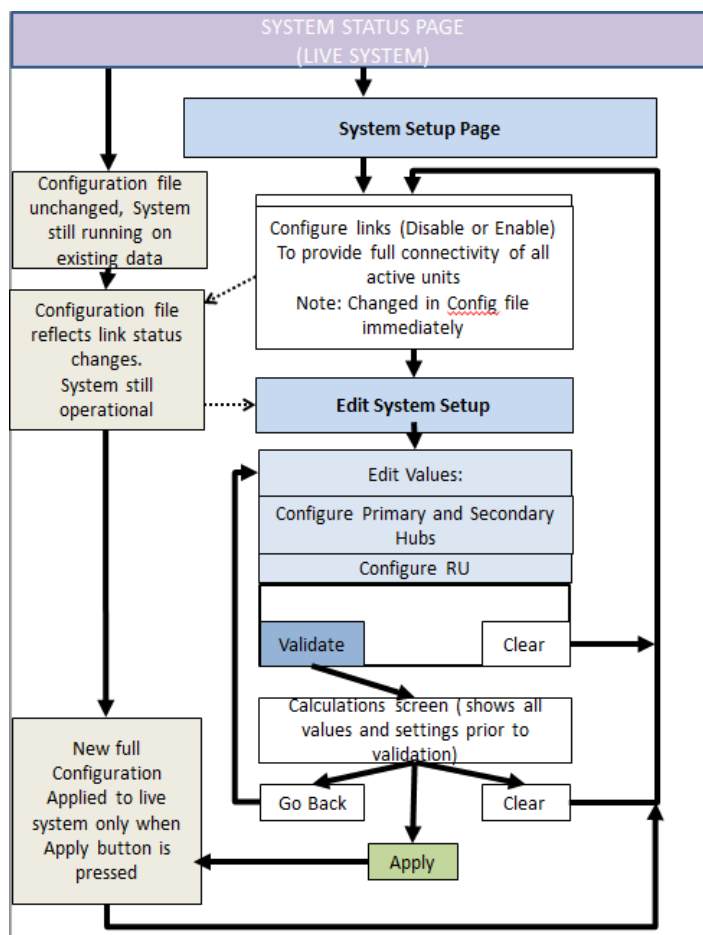
14.1 Managing Links by Viewing Status

When you access the System Setup page a System Setup summary is displayed. This is similar to the System Status page; however, it focuses on the signal routing matrix in the Primary and Secondary Hubs. The items shown are view-only.
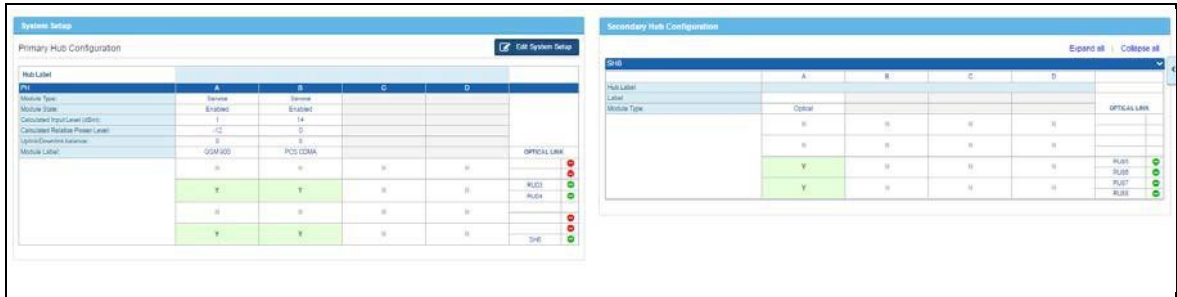
The system can only be set up when all links are complete (connected and calibrated and module LEDS are green). If there are links that are not complete these will be displayed.

To view and fix links:

1. Click **System Setup** from the left navigation bar.
    The System Setup window is shown with information about links in the System Status pane.
    For example, in the capture, incomplete links are shown.
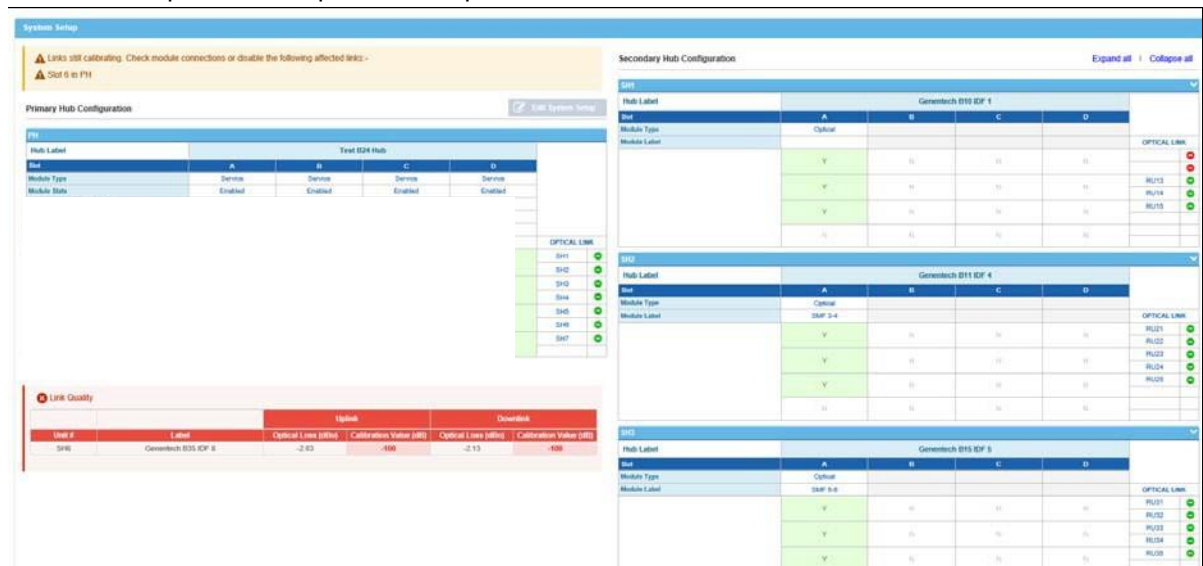
Depending on system configuration, there may be a lot of information on this page. You can expand and collapse a specific Secondary Hub configuration by clicking the Expand All or Collapse All links.

2. Correct Physical links as indicated to get a fully connected system.
    If the link has a valid Remote Unit attached you can either wait until calibration is complete or disable these links and continue. If the cause of incomplete links is due to Remote Units not being present then the appropriate module in the Hub can be disabled. If no Remote Unit is attached the link must be disabled for set up to complete.

In the example shown above the issue is caused by slot 6 in the Primary Hub not being able to connect to the associated Remote Unit (no power at the Remote Unit). See "Understanding Poor Optical Links" on page 14-4 for more information on Poor Optical Links.

3. Click on a Green icon to disable the unit, if desired.

   While being disabled the icon changes to a spinning red circle. After it is disabled a red Disabled appears for the item.

When a link is disabled in the GUI, Optical Module itself is disabled and the module's LEDs appear dull red.

Any changes made at this stage are implemented immediately allowing you to continue with setup if parts of the system are still being worked on.

4. Once all links are corrected, the Edit Setup button turns dark blue allowing you to input system values. See "Inputting System Values" on page 14-5.

Understanding System Setup

14.1.1. Understanding Poor Optical Links

The System Status and System Setup windows, indicate a problem on the Remote unit associated with the poor link. Links that are out of specification are highlighted with an orange exclamation mark in the System Status tree. You should investigate Link Quality to identify if this is a poor link issue.
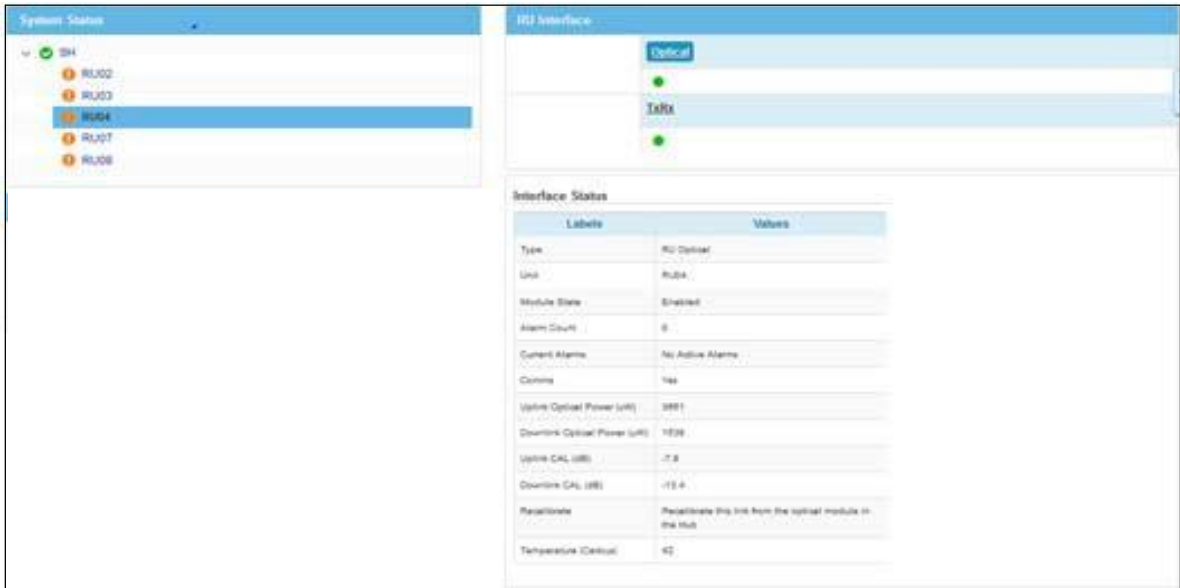
You can view the condition of all optical links in the system through the Link Quality System Tool. See "View Link Quality For Remote Units" on page 13-10 for more information about this feature.

The link quality table displays the optical loss in both the uplink and the downlink and the corresponding RF loss (Cal value). Where loss exceeds the value that can be corrected in the hardware, the value is Red. To assist in identifying other issues marginal, links are highlighted in Yellow.

The condition of each individual link can also be seen through the Optical Interface of the Remote Unit connected or through optical Module interface of Primary Hub to Secondary Hub links.

Links with high optical loss and calibration values impact system noise (due to optical devices being overdriven) and the ability of the system to achieve all the desired settings, including Remote Unit output power. Problems caused by poor optical links are displayed in the System Setup window as warnings.

> ⚠ **Caution:** While the system can be configured with poor links present, this will affect the system performance and such links should be examined and brought into specification in order to obtain optimum performance.

A poor link may affect connectivity of the system. Set up can only be run with a fully connected and stable system. When links have very high loss they often drop connections to the far end resulting in instability during the set up process. When a change in link status occurs during set up, the process will fail. Links with very high loss or bad calibration should be disabled via the System Setup window until corrected or addressed by cleaning and checking optical connections to allow for a smooth set up completion.

14.2 Inputting System Values

You can edit items already physically connected to the system and their links have been verified.See "Managing Links by Viewing Status" on page 14-2 above to manage links. Hardware must be installed and initially configured to proceed with System Setup. To add new hardware to the system, follow the instruction in "Changing or Swapping Equipment" on page 14-14. After all new connections are added, return to this screen to edit settings for the new devices.

To Edit system values:

1. Make sure all system links are corrected. See "Managing Links by Viewing Status" on page 14-2.
2. Click **System Setup** from the left navigation bar.
3. Click **Edit System Setup**.
   The system layout is shown as when you click the System Setup link from the left navigation bar; however, the items are now editable. The Primary Hub with service inputs is on the right side of the page. Secondary Hubs are shown on the left with Remote Unit configuration below the Secondary Hubs.
   For each hub, the matrix settings are displayed giving a visible indication of how services are mapped through to Remote Units.
   The discovered Service Modules are shown at the top of the matrix with Optical Modules connecting to Secondary Hub and Remote Units shown on the right of the matrix.

> **Note:** Service Modules, although present, do not have to be used. Service Modules in use should be marked as enabled. If no service is connected then these inputs should be marked as "disabled" so that the systems can calculate gains settings correctly.
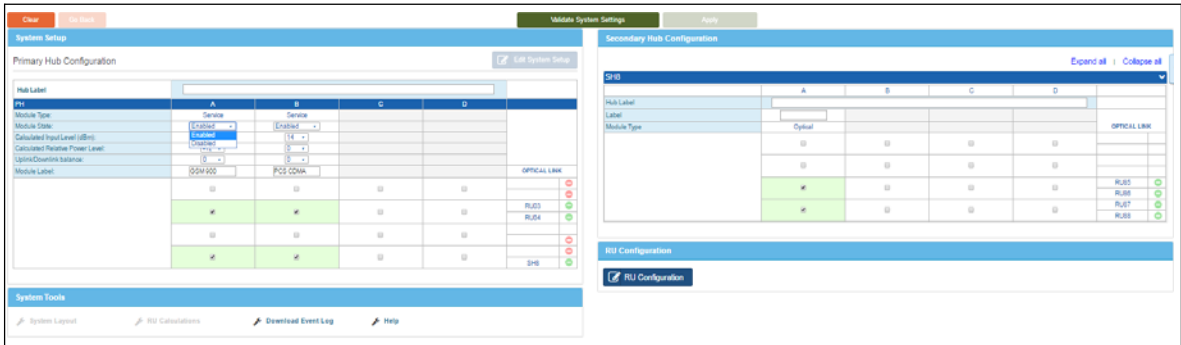
4. Edit the Hub label for the Primary Hub.

Value	Description
Hub Label	The name of the Hub. Free text field. 20 character limit. Special characters such as & and %. are not allowed; however, space and underscore are allowed.

5. Enter the following information for each enabled service module.

| Value	Description
Module Type	The type of Module (not editable).
Module State	Enabled or Disabled. Select disable if the Modules are inserted but service is not connected.
Calculated input level (dBm)	Measured composite power level delivered to the module from the Signal source. Select the numeric value from the pulldown. For more information on how to calculate the values, see "Calculated Input Level" on page 14-12. This a required field.
Calculated Relative Power level	Reflects the principles of composite power based on the number of services and channels for each service required to give uniform service coverage. Select the numeric value from the pulldown.These values are supplied to you and have been calculated using the Coverage Tool.
Uplink/Downlink Balance	Allows for variation in transmit and receive path directions depending upon system requirements. Select the numeric value from the pulldown (+10 and -10). For more information on how to calculate the values, see "System Uplink/Downlink Balance" on page 14-11. This a required field.
Module Label	Name of a module. Free text field. 20 character limit. Special characters such as & and %. are not allowed; however, space and underscore are allowed.

6. Check the desired boxes at the intersection of inputs and outputs.

Boxes should be green indicating good routing status.The Hub features a unique internal service distribution matrix that provides flexibility in terms of how supported wireless services are routed within a system deployment. This means specific operators or frequencies can be routed to the entire system or to designated sections of the system, depending on requirements.

When clicked the path is enabled. No check indicates that the path is closed and no signals will pass.

Note that if the matrix is not enabled correctly then a warning will appear during the setup process as without a complete path from service mode to remote unit appropriate internal setting cannot be made.
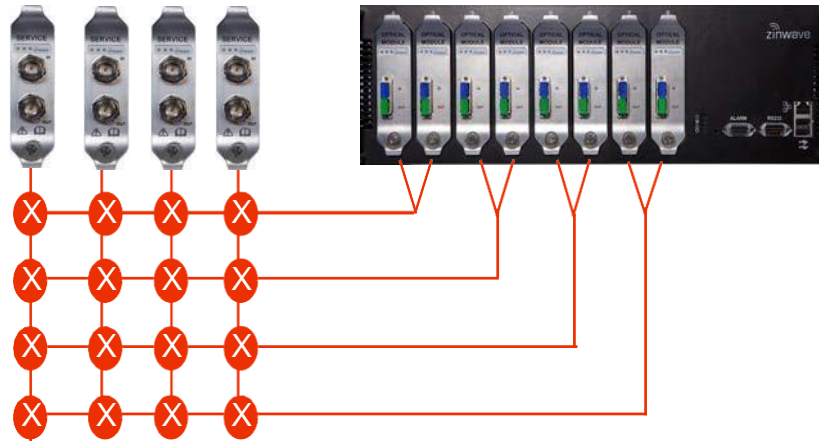
7. Edit the desired values for Secondary Hubs.

Value	Description
Hub Label	The name of the Hub. Free text field. 20 character limit. Special characters such as & and %. are not allowed.:However, space and underscore are allowed.
Label	Free text field. 13 character limit. Special characters such as & and %. are not allowed.; however, space and underscore are allowed.
Module Type	The type of Module (not editable).

Note: Hub types are assigned on the Hub Status page. See "Setting the Hub Type" on page 12-1.

Note: It is not possible to disable the input to the Secondary Hub as this would disconnect the Secondary Hub and make reconnection impossible.

8. Check the desired boxes to activate the signal routing matrix items.
Boxes should be green indicating good routing status.

Understanding System Setup

The status for Remote Units is shown.
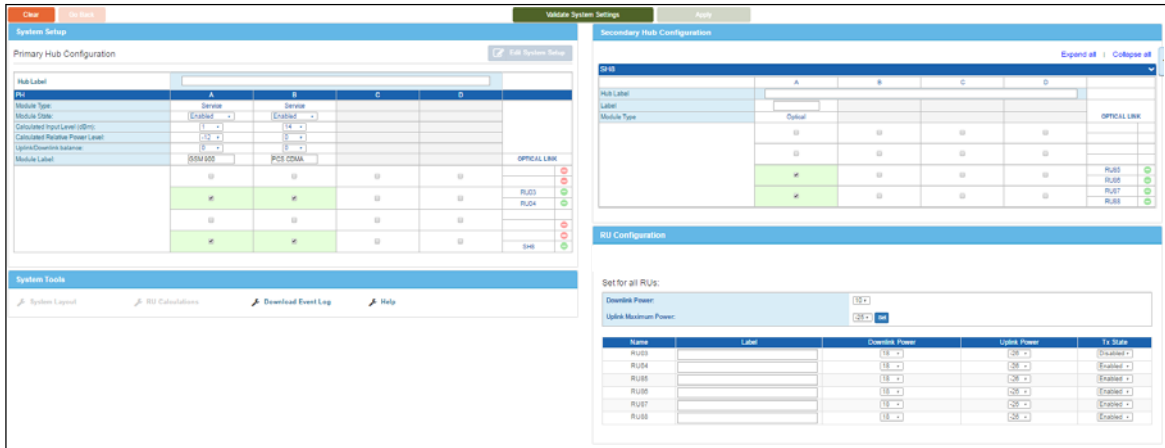
Remote Units are automatically assigned a number based on their position in the system. The number is based on the Primary Optical Module port number to which the Secondary Hub is attached (if any) and the port to which the Remote Unit is attached. For example,

Remote Unit Number	Primary Hub to Secondary Hub	Remote Unit Connection
RU31	3	1
RU32	3	2
RU33	3	3
RU04	No Secondary Hub	4

9. Enter the Downlink Power and Uplink Maximum Power for all Remote Units by selecting values from the pulldowns.
   See "Remote Unit Downlink Power" on page 14-13 and "Remote Unit Uplink Power Max" on page 14-14 for more information on calculating these values.

10. Click **Set**.

11. If these values apply to all Remote Units, skip to step 14.

12. Edit the desired values for the Individual Remote Units.

Value	Description
Label	The name of the Remote Unit. Free text field. Space and underscore are allowed.
Downlink Power	Downlink output power defines the geographic coverage of the Remote Unit in conjunction with the connected antenna. Select the numeric value from the pulldown. Default value is -10dBm. For more information on how to calculate the values, see "Remote Unit Downlink Power" on page 14-13.
Uplink Power	Influences a number of parameters including Uplink Gain and Noise. Select the numeric value from the pulldown. The default value is -25dBm. For more information on how to calculate the values, see "Remote Unit Uplink Power Max" on page 14-14.

Value	Description
Tx State	Enabled or Disabled. Disabled switches off the final stage power amplifier in transmit path (downlink direction) and the first low noise amplifier in receive path (uplink direction). Will remove service from areas covered by that particular. Default is Enabled.
Module Label	Name of a module. Free text field.
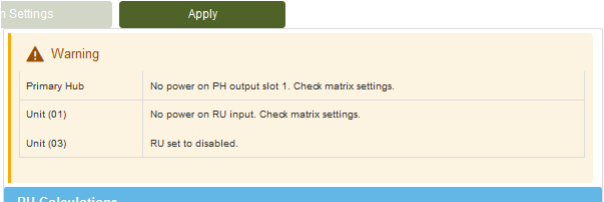
13. Click **Validate System Settings.**

Validate System Settings
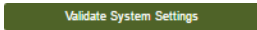
The system takes some time to calculate the inputted settings and validate them. A progress indicator is shown. It then returns with a screen similar to the initial status screen. It is not editable, however, it displays any warnings, errors, or link issues with system setup and the Apply button becomes active (dark).

Understanding System Setup

Notification	Description
Link Error	Shows optical links that are connected (allowing Setup to be completed) but where the measured optical or RF link performance across a fiber is greater than the maximum value that can be corrected by the hardware. These links are shown on the System Setup page and reported in Link Issues after validation.
	Links with issues impact noise (due to optical devices being overdriven) and ability to achieve desired Remote Unit output powers. Links issues should be addressed by cleaning and checking the optical links affected units.
Warnings	Warnings are used to indicate anomalies within the system that can be due to configuration errors or conflicts. These are not fatal but should be examined and assessed. These warnings are typically due to poor optical links with excessive loss, which means that desired output power cannot be achieved, or that matrix settings are not applied. In this example,
	there is a warning that the matrix has been set incorrectly on the Primary Hub resulting in no through RF path. This means that correct gains cannot be set and incorrect values used in the configuration
	In addition there is a warning that one of the Remote Units has been set to disabled.
Errors	These are fatal errors in the Setup process which prevent validation and Setup from completing. If an error is encountered, go back and check loaded values or optical link performance. The most common source of errors is due to the presence of un-calibrated optical links.

14. If you wish to modify the system settings due to warnings that were displayed, click **Go Back** to return to the applied settings and make changes or **Clear** to empty all inputted settings.

    The system performs on-going monitoring and self-checking process for the system topology. It automatically checks for the presence of Remote Units and Modules and the calibration state of all links. If anything is connected or removed from the baseline configuration, it is indicated on the System Status window. System Setup needs to be performed and validated to activate these changes.

15. When you are satisfied with the configuration, click **Apply**.

    The system applies all the input and output requirements to the internally calculated calibration measurements for each link. Together these are applied to the various gain blocks throughout the system to achieve the desired settings. This is carried out in line with a set of predefined set points designed to minimize noise result in gain settings for individual components.

    The system continually monitors and checks the system topology.

    Alarms and warning displayed on both Status and Setup pages

Note: All changes must be validated and applied.

16. If changes are required, repeat this procedure to input, validate, and apply them.

14.3 System Uplink/Downlink Balance

The uplink/downlink balance allows for variation in transmit and receive path directions depending upon system requirements.

With the uplink downlink balance at its default values of 0 the uplink and downlink gains are the set to the same value. A setting of 5 will request and uplink gain of 5dB higher than the downlink gain. Similarly, a setting of -5db will set the uplink gain at 5dB lower than the downlink.

Note: The maximum gain of the system is 25dB. If levels set in the system require greater gain, then Setup will not be possible.

The maximum system gain that can be set in either uplink or downlink directions is 25dB. The actual gain is set by many combinations of input, output and balance parameters.

The gain is primarily defined in the Downlink. The downlink gain, before service balancing, is determined by the Calculated Input Level and the Remote Unit Downlink power. For example to achieve a maximum downlink gain of 25dB with a maximum output level set at +18dBm the minimum input level that can be set is -7dB when a single service port is enabled. When the Uplink Downlink balance is set to 0dB, the system will try and set the uplink to the same value as the downlink gain.

However, the Uplink gain is also bound by the Uplink Power max setting on the Remote Unit and the target output level of the Service Module in the uplink direction. The target output value of the Service module is only -10dBm. Thus, if the downlink gain is set for maximum gain the Uplink Power max must therefore be set to -35dBm or lower if the uplink and downlink gains are to be equal.

> Input level -7dBm
>
> Maximum Output level +18dBm
>
> - Downlink Gain = 25dB
>
> With Uplink / Downlink balance set to 0
>
> Uplink target = 25dB
>
> Maximum output level (not configurable) =-10dBm
>
> - Uplink power max must be set to -35dBm to achieve uplink gain

If the balance is set to 0dB but the Uplink max power is set to -25dBm then the uplink gain will be limited.

> Input level -7dBm
>
> Maximum Output level +18dBm
>
> - Downlink Gain = 25dB
>
> With Uplink / Downlink balance set to 0
>
> Uplink target = 25dB
>
> Maximum output level (not configurable) =-10dBm
>
> Uplink power max set to -25dBm
>
> - Uplink gain = 15dB

If the Uplink / Downlink balance is set to -10 the uplink gain target will be set 10dB lower than the downlink.

Understanding System Setup

Input level -7dBm

Maximum Output level +18dBm

- Downlink Gain = 25dB

With Uplink / Downlink balance set to -10

(Uplink target = 15dB)

Maximum output level (not configurable) =-10dBm

- Uplink power max must be set to -25dBm. Note if the Uplink power max is set to less than -25dBm the noise figure will be improved but uplink gain will still be limited to 15dB due to setting of Uplink/ Downlink balance.

It is important to note that the System performs a gain self-calibration process when links are established using internally generated signals and measurement circuits. The self-calibration is designed to optimize the system gain settings for the required downlink output power and to minimize uplink noise figure for the required maximum input signal. To achieve these minimum noise figures there are a number of set points within the system which must also be achieved.

When setting the uplink maximum power, there are two key parameters to consider: noise and largest expected uplink input signal. The minimum uplink noise figure is achieved with the lowest uplink maximum power and the largest uplink gain. However, this will provide the least protection against uplink input signals, including any noise coupled from the downlink. In systems where Uplink noise is critical, such as UMTS, care must be taken to ensure that the SNR ratio in the uplink is maintained. The Zinwave coverage tool can be used to calculate appropriate levels.

The system up and down link gains are displayed during the Auto Setup process for each service input for each Remote Unit.

14.4 Calculated Input Level

The Calculated input level is the measured composite power level delivered to the module from the Signal source (BTS BDA etc.) with a frequency compensation factor to take into account the typical frequency response of the system. The total composite input power level should not exceed +15dBm

Care must be taken to ensure that the setting reflects the total power possible at the SM. It is important to know not only what is currently connected and being measured, but also what will be connected. Particular care should be taken when using CDMA signals where the initial power measured is often that of the Pilot and not the maximum transmit power. Similarly, with cellular services, initial measurements often do not show all traffic channels which will only be operational under loaded conditions.

It should be noted that the input level is alarmed to detect and protect the equipment from inadvertent or accidental overload of the incoming composite power. The performance of the overload protection is shown below
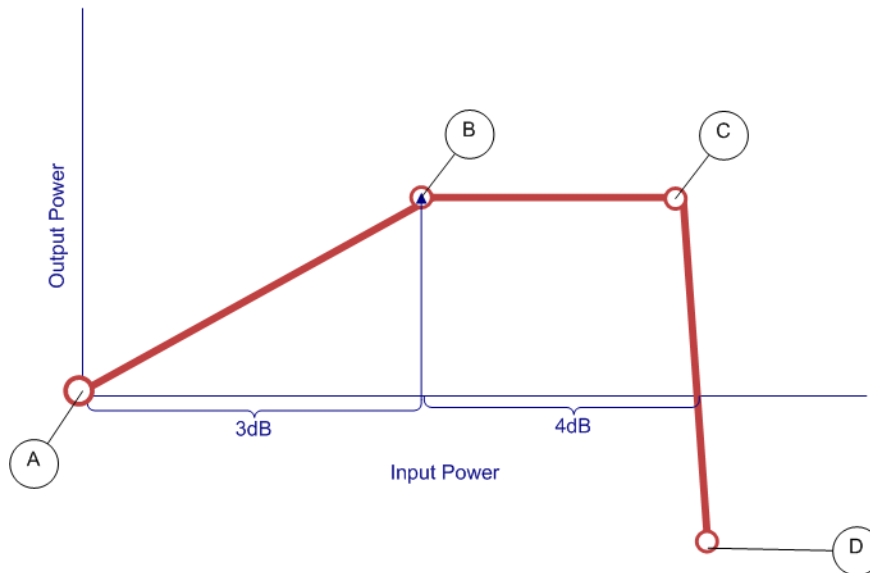
- A is the "calculated input level".
- In region A-B (0 to 3dB above the set input level) the corresponding output power will increase by the same level.
- In region B-C (4-7dB above the "calculated input level"), the power will be limited at the same level by switching in attenuation on the SM.
- In region C-D (greater than 7dB above the "calculated input level"), additional attenuation will be switched on, effectively shutting services connected to that input to the PH.

Other services will be unaffected.

14.5 Remote Unit Downlink Power

This value will be determined by the system design. The downlink output power defines the geographic coverage of the Remote Unit in conjunction with the connected antenna.

Notes on Remote Unit power:

- The maximum composite output power for all Services is a regulatory requirement and will vary depending upon where the UNItivity 5000 Platform is being deployed
- In CE Territories the Output power is limited to +18dBm
- In the USA where FCC regulations apply the maximum composite power can be +20dBm

The maximum EIRP is +20dBm for WLAN in Europe and +28dBm for all approved services in USA & Canada. This corresponds to antenna gains (including any cable and splitter losses) of 2dBi for WLAN in Europe and 8dBi for USA & Canada.

14.6 Remote Unit Uplink Power Max

The uplink power max influences a number of parameters including Uplink Gain and Noise.

The default value is -25dBm.

When setting the uplink maximum power there are two key parameters to consider: noise and largest expected uplink input signal. The minimum uplink noise figure is achieved with the lowest uplink maximum power and the largest uplink gain. However, this will provide the least protection against uplink input signals, including any noise coupled from the downlink. In systems where Uplink noise is critical such as UMTS care must be taken to ensure that the SNR ratio in the uplink is maintained. The Zinwave coverage tool can be used to calculate appropriate levels.

The uplink sensitivity is measured at the Remote Unit and it is generally assumed that there is no loss between the Remote Unit and the antenna. If there is additional loss, due to either additional cable loss or filtering, this can change the sensitivity setting (if desired) as it may increase isolation between Tx and Rx paths.

The impact of the inclusion of additional loss, in terms of sensitivity, can be seen in the coverage tool by changing the value "Isolation Measurement Adjustment" in the UL sheet.

The value set for Uplink Power max is also protected to prevent damage in the presence of large unwanted signals. The method of protection is the same as the service input settings. 3dB above the value will result in a corresponding increase in signal output at the Primary Hub output but beyond this AGC will be applied and at 7dB the Remote Unit input will be shut down.

14.7 Changing or Swapping Equipment

If equipment is removed from an existing system, the system will recalibrate links and apply stored configuration settings. This will be shown in System Setup with a message like, "The following remote units are missing. Apply a new system setup to acknowledge them". This is because the system has changed from the "baseline" configuration set up after the Apply button was pressed.

Do not make any equipment changes while the system is validating its set up as this will invalidate any System Setup process and the setup will fail. A message will be displayed indicating the failure and request that you restart system set up. If this happens, rerun the system setup and validation after equipment has been added or removed.

14.7.1. Hub

If a Hub is disconnected from the system due to failure of power or optical link, for example, when the same unit is reconnected it will resume its defined configuration. If a different unit is installed in its place, the new unit will have factory default configuration (unless previously configured elsewhere) and must be changed through the Hub Setup page and by re-running the System Setup process to set the correct matrix configuration.

14.7.2. Remote Unit

If a Remote Unit is disconnected from the system, when the same unit is reconnected to the same optical module the, the system recalibrates the links and applies the stored settings. If a different unit is reconnected, the system sets the unit to its default condition. Edit the system settings to input custom values.

14.7.3. Optical Module

If a link is broken either due to fault or intervention the system automatically recalibrates the link and applies the appropriate gains when the system is restored even if a different unit is swapped in to the system.

Chapter 15: Understanding Hub Setup

While System setup configures how the system works together, Hub setup configures the individual Primary and Secondary Hubs. These functions are needed for initial hardware installation as well as ongoing updates.

15.1 Configuration Files

Once the system has been set up the Hub configuration can be saved. This can provide a restore facility if the system has to be backed up to an earlier version of configuration. The config file (.cfg) includes IP address information, matrix settings and Remote Unit settings for a Hub. You cannot use a single config file for multiple Primary Hubs or Secondary Hubs. The config file for each unit should be saved with a unique file name.

It is recommended that when system set up is complete the configuration file is saved.

To save a Hub configuration:

1. Click **Hub Setup** in the left navigation bar.
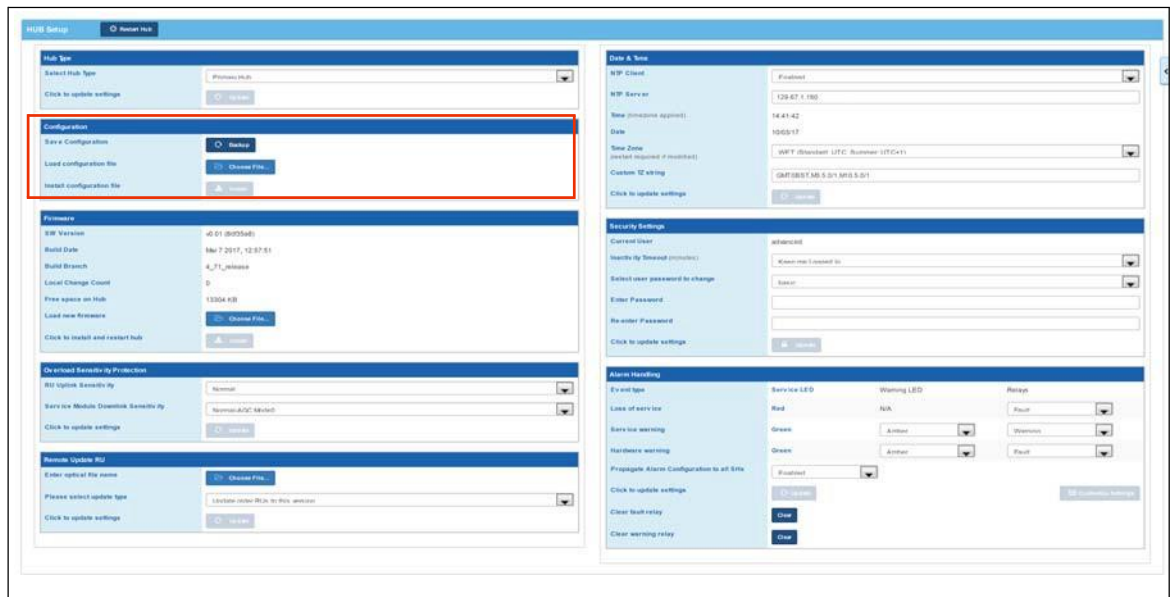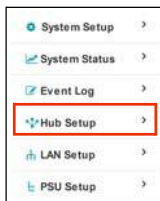
2. In the Configuration pane, click **Backup**.
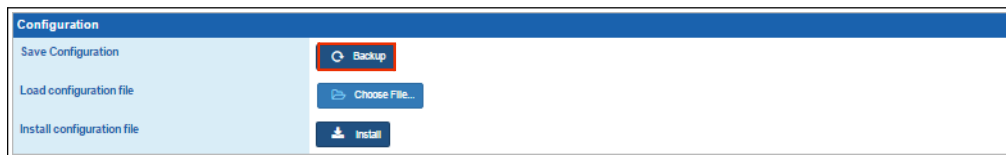
Depending on your browser, the file is saved to your computer's file system. For example Chrome places it in a Downloads folder.

3. Navigate to the saved file and rename it to the Hub label set in System Setup.

Understanding Hub Setup

To load a Configuration File:

1. Click **Hub Setup** in the left navigation bar.
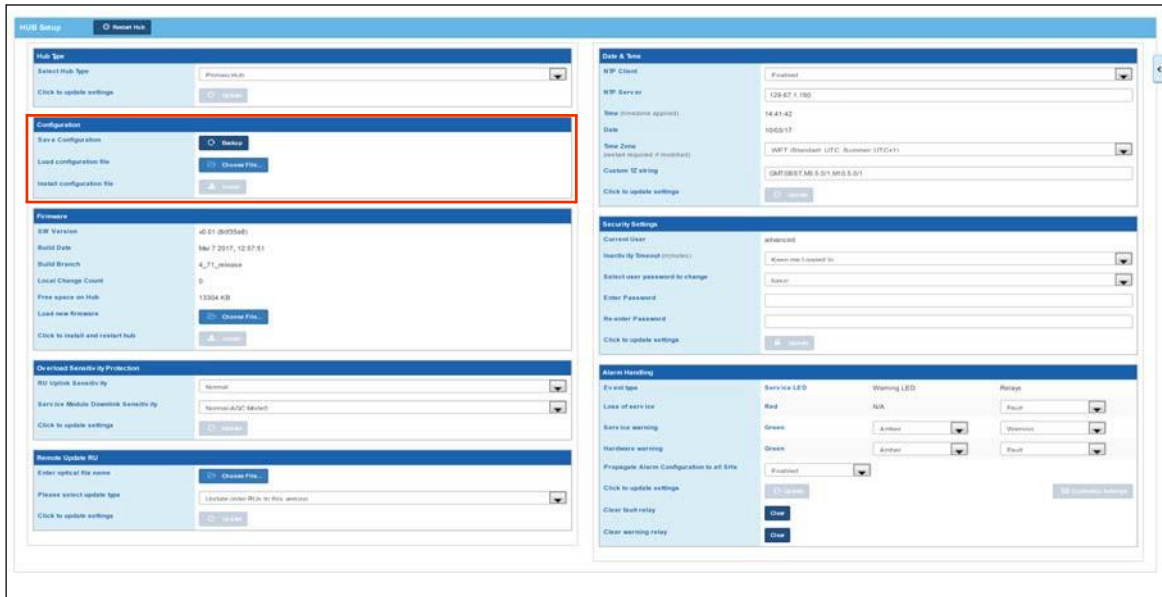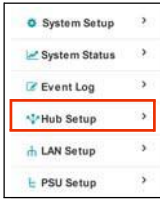
2. In the Configuration pane, click **Choose File**.
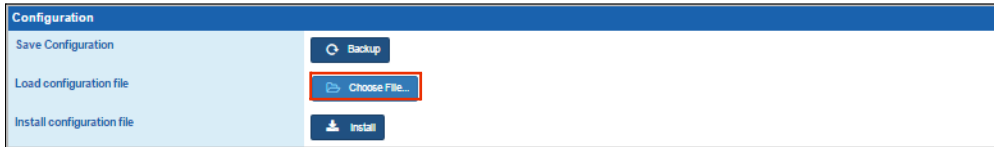
3. Navigate to the desired configuration file and select it.
4. Click **Open**.
5. Click **Install**.
6. Click **Restart Hub** at the top of the window.

15.2 Restarting the Primary Hub

A hub will restart under certain conditions such as changing time zone and updating software. However, the function of this button is to provide a software restart. It should not be used unless a forced restart for the system is required or suggested by Zinwave support staff.

To restart a Hub:

1. Click **Hub Setup** in the left navigation bar.
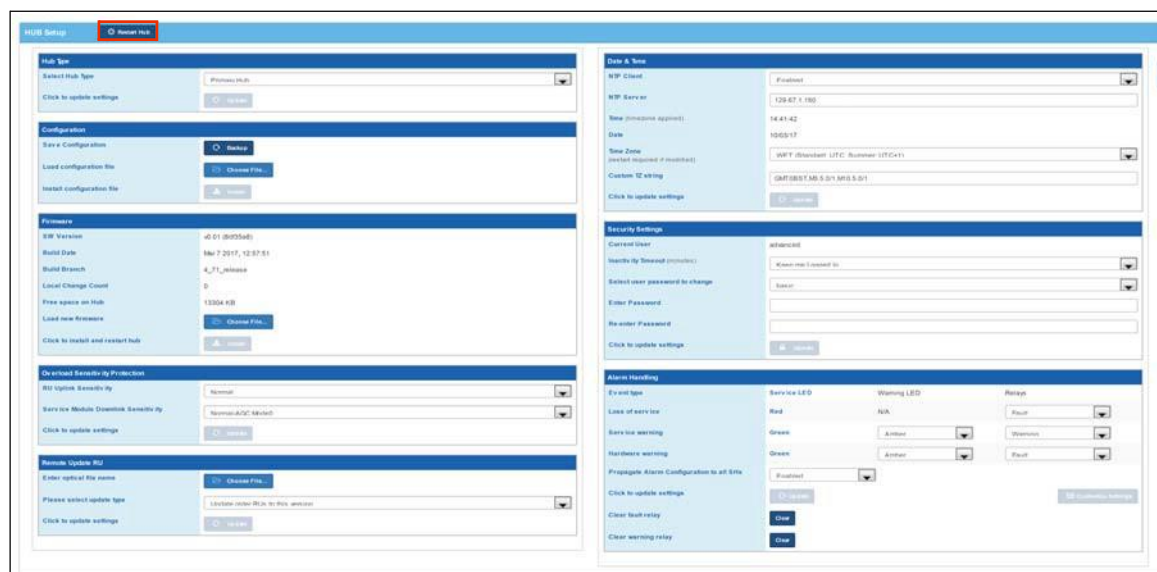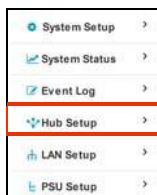
2. At the top of the page, click **Restart Hub**.

15.3 Factory Reset of a Primary Hub

It may be necessary when redeploying or reconfiguring equipment to set the Hub back to factory default values.

The reset button can be found behind the small hole located to the left of the Alarm Serial interface. If an installation was interrupted or if there has been a catastrophic issue with a Hub that cannot be recovered, you can return the Hub to factory settings. This requires a physical reset to the system.

Understanding Hub Setup

To reset a Hub to factory settings:

1. Using a small device (such as an open paper clip), push the Reset button located on the front of the Hub and hold in for 5 seconds.

You need to insert the tip of the device into the hole as the button is set in from the front face. The Hub restarts and the LEDS flash. The Hub is returned to the default IP address and configuration settings:

- IP Address: default 192.168.0.2
- Sub Net: Default 255.255.255.0
- Gateway: Default 192.168.0.1
- Passwords: Advanced: supervisor
- NTP Settings: default disabled
- Alarm Settings: default condition Fault
- Hub Type: Primary Hub

2. Configure as desired as described throughout this manual.

15.4 Remote Unit Settings

You can set the Remote Unit overload sensitivity and update Remote Units

15.4.1. RU Uplink Sensitivity

You can protect the Remote Unit from very high signal levels. The AGC/Overload monitoring is done in the Remote Unit using thresholds supplied by the Hub.

The reaction of the overload is in real time and immediate. The AGC kicks in as soon as the power level detected reaches the threshold set. There is no set period that must expire before the AGC is cleared. It is cleared as soon as the power level drops. Since the Remote Unit constantly monitors, as soon as the power level drops below the threshold (minus the 0.5db margin), the system becomes fully operational. There is a 0.5 dB hysteresis built into the software on the power level monitoring to stop the AGC/Overload from oscillating.

To set Remote Unit signal sensitivity:

1. Click **Hub Setup** in the left navigation bar.
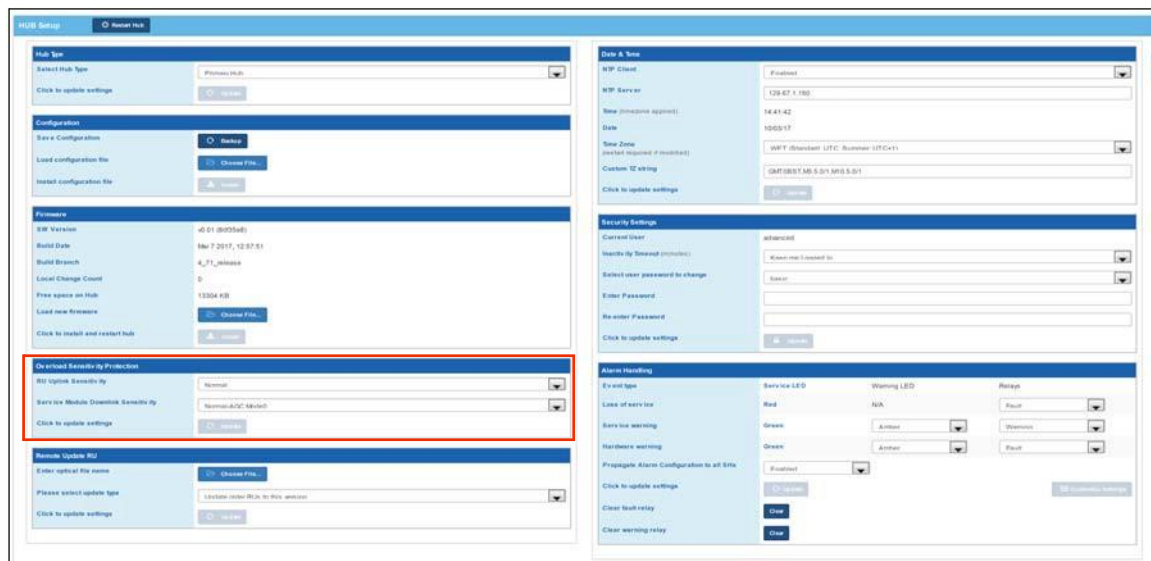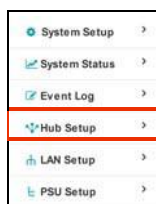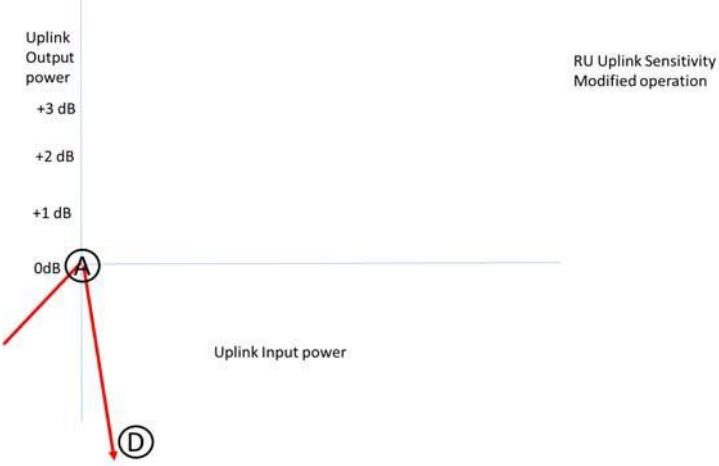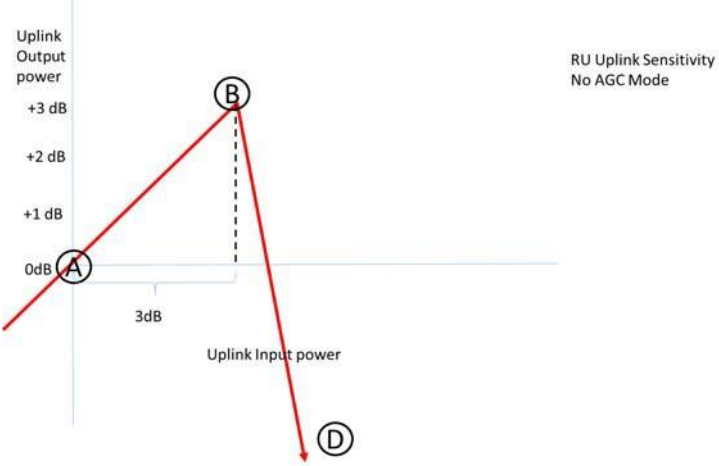
2. Select the desired sensitivity from the RU Uplink Sensitivity pulldown in the Overload Sensitivity protection pane.

Type	Description
Normal	Provides overload protection in accordance with regulatory standards for spurious emissions. For example, Point A is the value set in system setup for "Uplink Power". The default value for this is -25dBm. In this case, if the composite RF input signal increases by up to 3 dB (Point B) above, the set Uplink power value the remote will continue to operate normally and the output will increase linearly by 3 dB. If the signal level increases further the Remote unit will apply AGC and limit the signal level (Points B to C). If the signal level increases to more than 7 dB over Point A the remote unit will shut the input power off completely.

Type	Description
Modified	More sensitive protection. For example, Uplink Output power +3 dB +2 dB +1 dB 0dB (A) Uplink Input power (D) RU Uplink Sensitivity Modified operation In modified mode the Remote Unit shut off occurs at the specified input level. This is the most sensitive setting and is used for specific service types.
No AGC	No overload protection.For example, Uplink Output power +3 dB +2 dB +1 dB 0dB (A) (B) 3dB Uplink Input power (D) RU Uplink Sensitivity No AGC Mode In No AGC mode the Remote Unit shut off occurs after a 3 dB linear increase.

3. Click **Update**.

15.5 Service Module Downlink Sensitivity

You can protect the Service Module from very high signal levels. This is only applicable to Primary Hubs.
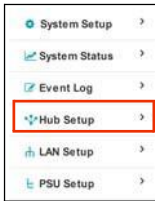
To set Service Module signal sensitivity:

1. Click **Hub Setup** in the left navigation bar.
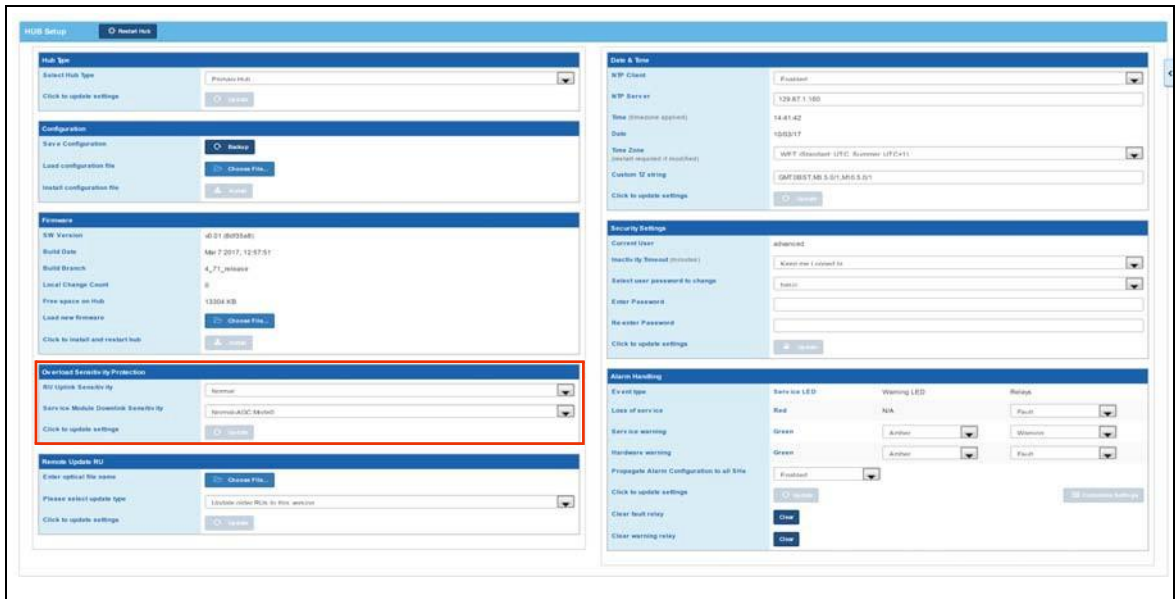
2. Select the desired sensitivity from the Service Module Downlink Sensitivity pulldown in the Overload Sensitivity protection pane.
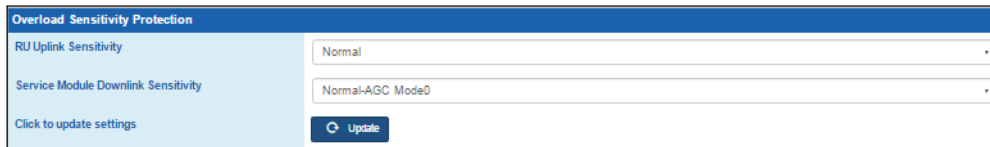
There are six settings:

Type	Description	Linear Increase (above Calculated level)	AGC Range (output limited to max linear increase
Normal-AGC Mode0	Provides overload protection in accordance with regulatory standards for spurious emissions. Default.	0-3 dB	3-7 dB
AGC Mode1	Provides a maximum overload of 7dB compared to the Calculated Input Level. Only use when recommended by Zinwave.	0-4 dB	4-7 dB

Type	Description	Linear Increase (above Calculated level)	AGC Range (output limited to max linear increase
AGC Mode2	Provides a maximum overload of 7dB compared to the Calculated Input Level. Only use when recommended by Zinwave	0-5 dB	5-7 dB
AGC Mode3	Provides a maximum overload of 7dB compared to the Calculated Input Level. Only use when recommended by Zinwave.	0-6 dB	6-7 dB
AGC Mode4	Provides a maximum overload of 7dB compared to the Calculated Input Level. Only use when recommended by Zinwave.	0-7 dB	NA
No AGC (0)	No AGC range and cuts off if the input signal exceeds the specified level by more than 3dB. Only use when recommended by Zinwave.	0-3 dB	NA

Under normal operation Point A is the value set in System Setup for Calculated Input Level dBm. "Calculated Input Level" on page 14-12.
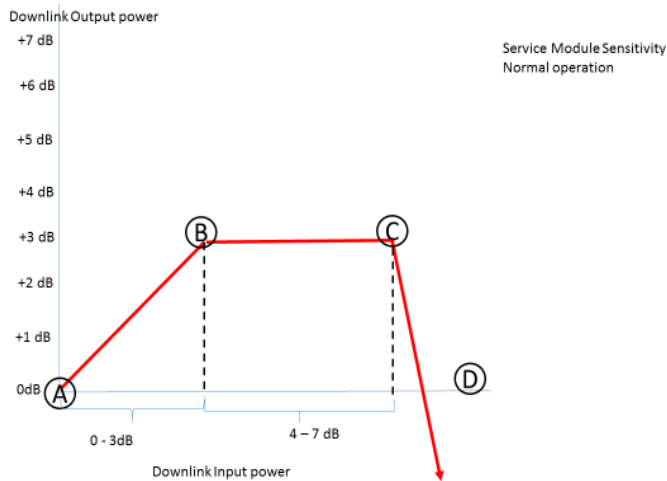
Understanding Hub Setup

In this case if the composite RF input signal increases by up to 3 dB (Point B) above the specified Calculated Input Level value the Service Module will continue to operate normally and the output will increase linearly by 3 dB.

If the signal level increases further the Remote unit will apply AGC and limit the signal level (Points B to C). If the signal level increases to more than 7 dB over Point A the module will shut the input power off completely.

In order to provide flexibility and to account for possible gain variations the 5 alternate settings have been provided. Modes 1-4 provide different ranges for linear increase compared to AGC.Mode 0 provides no AGC range and cuts off if the input signal exceeds the specified level by more than 3dB
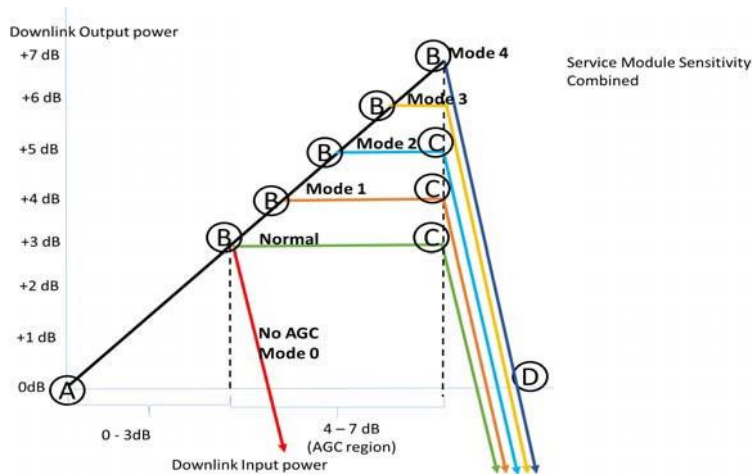
These should only be used under advice from Zinwave.

3. Click **Update**.

Chapter 16: Understanding Alarms and Reporting

16.1 Alarms

The term Event is a generic term for any occurrence in the system that could cause an entry in the event log to be generated. Events are defined into four categories.

- Loss of Service
- Service warning
- Hardware Warning
- Informational

Some events also cause alarms, and are sub-divided as described in the following sections. All of these event types are recorded in the log files accessible in the Configuration GUI. See "Event Log" on page 17-3.

16.1.1. Loss of service

This type of event occurs when the Primary Hub detects an event that will result in the ***complete loss*** of 1 or more services in at least 1 RU location, e.g. a link calibration failure, Overload "Safe Mode", RU communication timeout, thermal shutdown, etc.

A typical example of a loss of service alarm occurs when a Remote Unit is disconnected from the system.

The log file will show the following type of behavior (Note log files are in chronological order)

```
2014-08-15 19:23:31: Cleared loss of service alarm: "Device is missing" on RU S/N:
310220000081 RU System
2014-08-15 19:23:31: RU02 (0x01D90611) detected connected to Optical Module 2
2014-08-15 19:23:31: RU02 (0x01D90611) has been deleted
2014-08-15 19:23:31: Raised loss of service alarm: "Device is missing" on RU S/N:
310220000081 RU System
```

16.1.1.1. Loss of Service Alarms

Alarm	Description	Action
Calibration error	An error has occurred in the calibration of an optical link.	Either carry out a manual recalibration through the status page for the relevant module or remove the optical cable which will force a recalibration to occur. If the fault persists check the equipment at both ends of the affected link.
RU services are restricted by a missing Service Module, or by matrix settings	The system cannot be configured as desired and some services will not be present due to incomplete Matrix settings.	Check that each Matrix has valid input and output paths set
The uplink power has exceeded the safe limit, and the receiver has been turned off	The power in the uplink (primarily the Remote Unit) has exceeded the defined threshold. This will cause the LNA in the Remote Unit to switch off until the overload condition is removed. It can be caused by uncontrolled uplink power from Mobiles or by poor installation causing reduction in Tx Rx isolation.	Remove the overload condition
The downlink power has exceeded the safe limit, and the receiver has been turned off	This relates primarily to the service Module and is raised when the downlink power from the connected BTS or Repeater exceeds the specified input level.	Check the measured input level and either modify input settings value or reduce BTS input level to the level required.
Device is missing	A unit that was present at the application of Auto setup is no longer connected to the system.	Correct or accept

16.1.2. Service Warning

This type of event is one that may be affecting the performance of at least 1 service in at least 1 RU location, e.g. a bad optical link, Overload "AGC Mode", etc.

```
E2014-07-03 14:51:07: Raised service warning alarm: "Uplink has poor RF performance"
on PH Optical Module 1
```

16.1.2.1. Service Warning Alarms

Alarm	Description	Action
Configuration has not been confirmed by the user	The settings of the system need to be confirmed by running auto setup.	Validate Setup.
The requested composite power could not be achieved	The output power requested at set up for a Remote Unit cannot be achieved. This will be due to a poor optical link which requires too much compensation (gain).	Check Optical connections and link quality.
Uplink Automatic Gain Control activated	This indicates that the Remote Unit has detected a signal above its defined threshold. It is currently working in the "safe" region before it switches off completely.	This indicates that the remote unit is sensing a higher than expected uplink RF level. This may be due to the temporary presence of a high power mobile without power control close to the antenna or a lack of isolation between transmit and receive antenna ports. If the condition is transitory then consider setting the Uplink sensitivity to a higher level. If the alarm is due to poor isolation between antennas either space antennas correctly or adjust uplink sensitivity setting for this remote unit.
Downlink Automatic Gain Control activated	This indicates that the Service Module has detected a signal above its defined threshold. It is currently working in the "safe" region before it switches off completely.	This indicates that the service module is sensing a higher than expected uplink RF level from the connected RF source. This may be due to an incorrect setting for input power or an unexpected increase in BTS output. Check the measured input signal to the Service module and against expected input signal loading and levels, paying special attention to level changes caused by pilot back off. If the level has increased due to unexpected increase in either channel numbers or service types, check with BTS providers and modify setting accordingly.
Uplink has poor RF performance	The uplink optical link has poor performance usually due to high optical loss.	Check and clean link.

Understanding Alarms and Reporting

Alarm	Description	Action
Downlink has poor RF performance	The downlink optical link has poor performance usually due to high optical loss.	Check and clean link.
Uplink gain is limited by the maximum allowable output power of a Service Module	The uplink gain is limited by the maximum input signal level at the Remote Unit and the maximum output level of the Service module (-10 dBm).	The system will automatically try and set the uplink gain to be the same as the downlink gain. If the uplink sensitivity is set too high this will limit the uplink gain and will raise this condition.
UL gain setting too high, decrease balance "Required uplink gain is too high."	The uplink gain is potentially greater than the downlink gain.	The system will automatically set the Uplink gain to be the same as the downlink gain with a UL/DL balance of 0, but will show this condition indicating that the UL /DL balance can be adjusted if required.
Input level too low - changing to appropriate level "The SM Calculated Input Level has been changed to prevent the downlink gain from being too high."	The system cannot achieve the required output with the input level set on the Set Up page. The system has a maximum gain of 25 dB between service level input and Remote Unit output power settings.	If the value provided at System setup requires greater than this the input value will be adjusted while maintaining the requested output power The delivered input power should be adjusted (raised) to ensure that excessive gain is not required.
Different power levels on uplink matrix input	The system has detected that there are inconsistencies with the automatic setting of the internal system parameters due to in equalities in connected components.	This should not prevent satisfactory operation but all set values for all elements connected to the affected Matrix should be checked (RU output etc power and all l optical links should be checked to ensure that they are performing inside optical limits.

16.1.3. Hardware Warning

This type of event is one that may be affecting the performance or lifespan of a component, e.g. temperature, voltage or current limits, fan failure, etc.

```
2014-08-15 19:24:11: Raised hardware warning alarm: "The uplink power is above the
upper limit" on PH Optical Module 2
```

In each case of a hardware warning the unit identity is included in the message.

This condition can also be cleared if you disable the faulty component through the System Setup window, or Apply a new set of parameters that disable the potentially affected service(s) at the affected location(s). For Hardware warnings this condition is also self-cleared by the Hub if the component returns within limits.

16.1.3.1. Hardware Warning Alarms

Alarm	Description	Action
The module temperature is above the limit The module temperature is below the limit	In each case the unit affected will be included in the log message Example "The module temperature is above the upper limit" on PH PSU. The cause will be the ambient temperature of the device in question.	Adjust the temperature or trace the specific problem through the equipment. See specif over and under temp alarms below.
Current1 over limit Current1 under limit Current2 over limit Current2 under limit Voltage1 over limit Voltage1 under limit Voltage2 over limit Voltage2 under limit	This indicates a problem with the power supply rails of the device in question. In the case of Optical Modules, Service modules and Hub alarms it relates to the Hub Power supply. If the alarm is raised in conjunction with a Remote Unit the fault will be with local unit or the centralized feed.	Contact Support and arrange for unit RMA in accordance with you maintenance and support agreement.
3.3 volt supply fault +ve 5 volt supply fault 15 volt supply fault -ve 5 volt supply fault Optical communications fault PSU 13v supply fault PSU 3.3v supply fault PSU 8v supply fault PSU -ve 12v supply fault PSU comms error PSU 13v supply current over limit Power supply fault	These are Hub alarms indicating problems with the Hub power supply. Some are used directly by modules and others are intermediate step down voltages.	
Fan fault	The fan speed is monitored as part of the internal control of the Hub. A fan fault will either indicate a power supply issue or functional problem with the fan.	Check for build-up of dirt and dust and replace as required.

Alarm	Description	Action
The uplink power is below the lower limit	The received optical power is below the minimum threshold for satisfactory operation and will result in any connected modules being disconnected/ deleted. The problem can be either a power failure at the far end or a break in the optical fiber cable.	Check the optical connection and fibers for damage, cleanliness and poor connection. If necessary clean both side of the optical interface carefully and replace if damaged.
The uplink power is above the upper limit	The optical power level exceeds the maximum value in the case of an optical link or if reported in conjunction with a Remote Unit identity indicates that the overload value for the Remote has been exceeded.	In the case of the service module this will be due to higher than expected RF signal levels from the connected RF sources. Measure input signal and check against the set value. Correct settings or report increase in BTS signal to operator.
The downlink power is below the limit	The received optical power is below the minimum threshold for satisfactory operation and will result in any connected modules being disconnected/ deleted. The problem can be either a power failure at the far end or a break in the optical fiber cable.	Check the optical connection and fibers for damage, cleanliness and poor connection. If necessary clean both side of the optical interface carefully and replace if damaged.
The downlink power is above the limit	The optical power level exceeds the maximum value in the case of an optical link or if reported in conjunction with a Service Module indicates that the stated input level has been exceeded.	In the case of the service module this will be due to higher than expected RF signal levels from the connected RF sources. Measure input signal and check against the set value. Correct settings or report increase in BTS signal to operator.
System error	This indicates a low level system error in the reporting unit.	These are non critical errors and alarms that may occur as part of normal operation. They are not critical and can be masked if required.

16.1.4. Informational

This category covers information presented to the user in the log file which records events that have been carried out by the user such as application of a new system set up, changing time and date or passwords. These are for information only and will not raise an alarm.

```
2014-06-13 14:33:22: New System Setup being set by: advanced.
```

16.2 Alarm Handling

16.2.1. Clearing Relays

You can clear fault or warning relays. This requires Advanced user privileges. When connected to a Primary Hub, all Secondary Hub relays are also cleared. When Connected to a Secondary Hub, only the relays on the Hub connected are cleared.

To clear Fault or Warning Relays:

1. Click **Hub Setup** in the left navigation bar.
2. In the Alarm Handling pane, click the **Clear** button next to Clear fault relay or Clear warning relay.

16.2.2. Alarm Handling Configuration

You can change how the Hub is configured to react for the three Event types (loss of service, service warning, and hardware warning). Where applicable, you can change the Warning LED and Fault relay via the software.

You only need to setup alarms for the system via the Primary Hub. If enabled, the settings filter down to all connected Secondary Hubs. Propagation is by default set to Enabled. If one or more Secondary Hubs needs a different configuration, it is advised to set all to the same and then manually connect to individual Secondary Hubs

Understanding Alarms and Reporting

To change alarm handling settings:

1. Click **Hub Setup** in the left navigation bar.
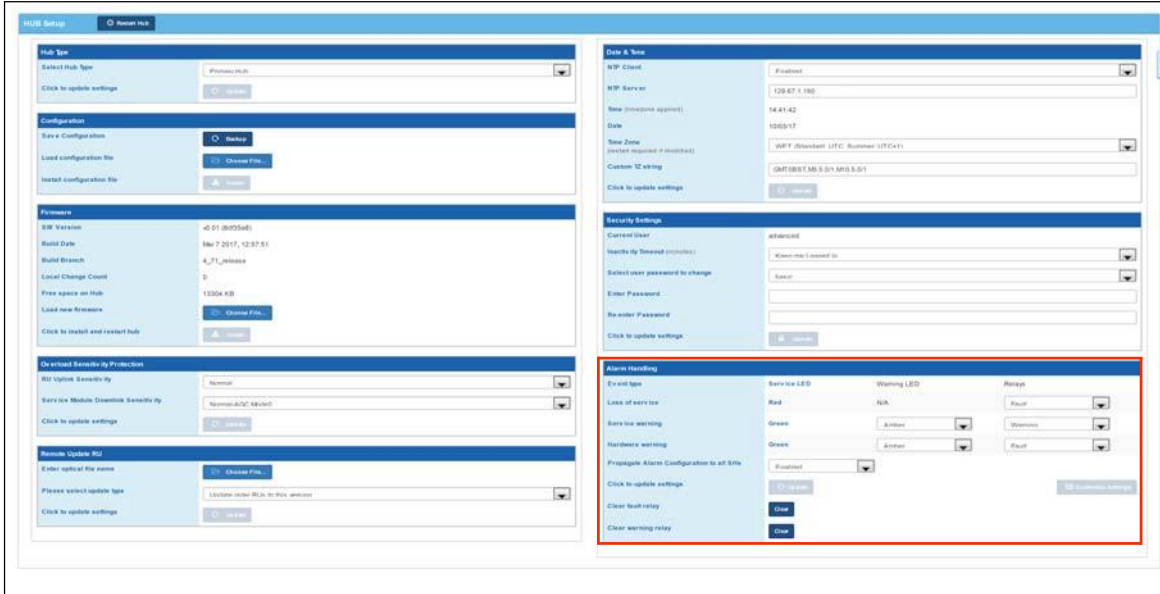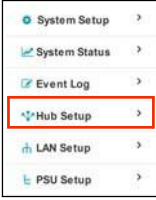
2. In the Alarm Handling pane, select the desired settings from the pulldown where available.
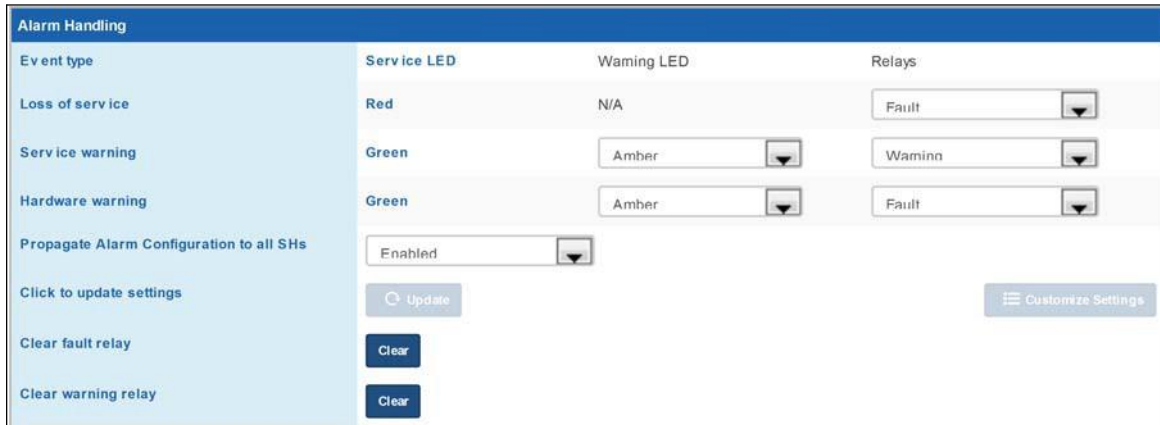
Event Type	Service LED (not editable)	Warning LED	Relays
Red	Red	N/A	Fault, Warning, or Ignore, Custom
Green	Green	Green or Amber	Fault, Warning, or Ignore, Custom
Green	Green	Green or Amber	Fault, Warning, or Ignore, Custom

If **Custom** is selected, the **Customize Settings** button is activated. Click this button to enter the desired custom settings.
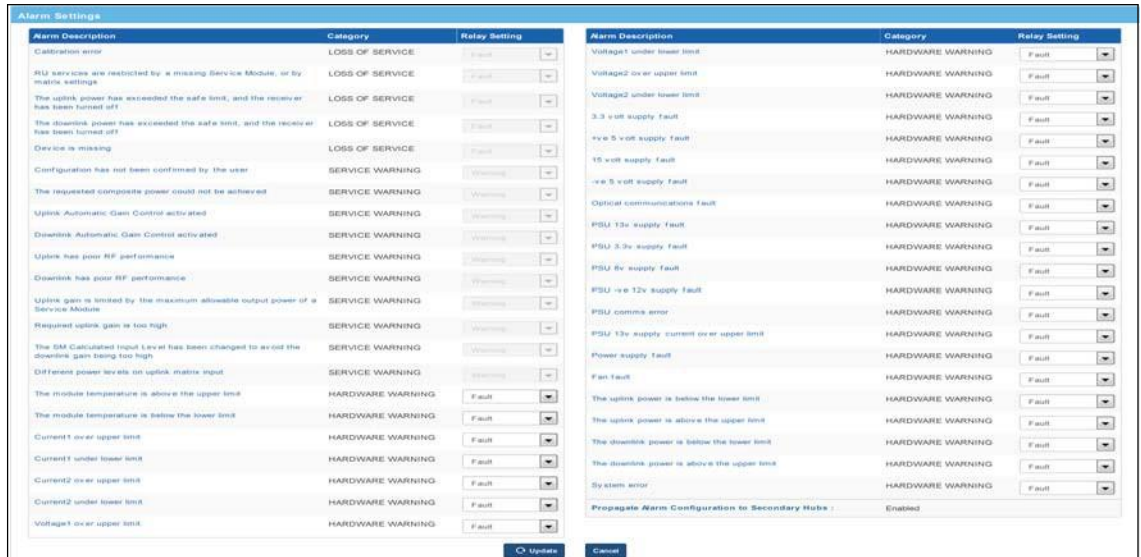
Depending on relay selected, options may be grayed out or available.

Select the desired options from the pulldowns and click **Update**.

3. Click **Update**.

16.3 Alarm Connections

UNItivity 5000 can connect to external alarm sources or monitors via the 9-way D-type connector on the Primary and Secondary Hubs. The connector provides 4 relay outputs: normally open alarm; normally closed alarm; normally open warning; normally closed warning.
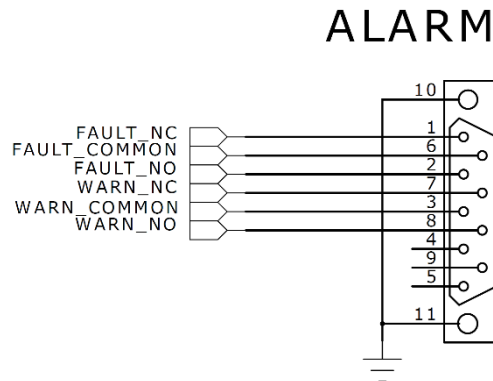
The relays are activated by an alarm or warning event. The relays are deactivated by clearing the alarm or warning condition and resetting the alarm/warning filter.

16.4 SNMP

An SNMP interface supports integration with higher order NMS applications. Security features such as separate user classes and secure communications via SSH & SSL are provided, along with support for secure SNMP v3. Local diagnostics are also available via LEDs indicating equipment status on the Hubs for rapid fault isolation.

The Hub firmware supports an SNMP v2 MIB interface, to remotely monitor the system by connecting SNMP Master Devices, such as Network Operation Center software, to Hubs. Both Hub types support the SNMP interface, but it is recommended that only the Primary Hub's interface is monitored, otherwise an alarm originating on a Secondary Hub can be reported by both.

SNMP Get and SNMP Traps are currently supported, the following tree view shows the structure of the interface:
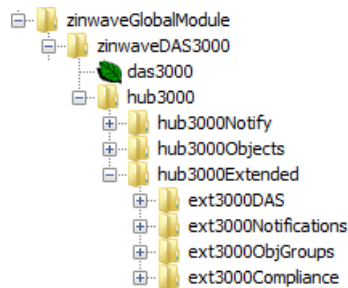
16.4.1. Snmp Trap Events

The Fault Relay Status trap will be sent for all alarms which are reported by the Primary Hub. The Fault Relay activates and the SNMP fault relay status trap is sent, in the event of an alarm. When the first trap is sent, the fault relay is set, subsequent traps are sent for additional alarms raised even if the fault relay has not been cleared. This feature is not enabled during the first 5 minutes from power on of the system. This initial start-up phase is to allow for any transient start-up alarms which may occur prior to the system coming online.

It should be noted that neither relay is self-cleared when the triggering alarm is cleared. Relays must be cleared manually via the GUI.

16.4.2. SNMP Get Objects

The following objects can be queried using v2 SNMP Get requests:

- Hub3000Objects.Hub3000String – This is the label of the Hub, as has been set in System Setup.
- Hub3000Objects.Hub3000DeviceType – This is the type of UNItivity 5000 unit.
- Hub3000Objects.Hub3000ModelName – This is the model name of the UNItivity 5000 unit.
- Hub3000Objects.Hub3000FaultRelayState – The state of the fault relay, either set(1) or cleared(0).
- Hub3000Objects. Hub3000FaultDescription – A description of the last fault detected by the system.
- Hub3000Objects. Hub3000PrevFaultDescription – A description of the previous fault detected by the system.

16.4.3. SNMP Traps

The following SNMP traps are supported:

- Hub3000Notify.Hub3000Heartbeat – This is a heartbeat trap which is sent every 20 minutes to the listening SNMP manager. It contains the following objects: Hub3000String, Hub3000DeviceType, Hub3000ModelName, Hub3000FaultRelayState
- Hub3000Notify.Hub3000FaultRelayStatus – This trap is sent each time a new alarm is raised in the system, and when the fault relay is manually cleared from the PH GUI. It contains the following objects: Hub3000String, Hub3000DeviceType, Hub3000ModelName, Hub3000FaultDescription, Hub3000FaultRelayState

The IP address and port of the SNMP trap receiver (SNMP Manager), is set via the LAN Setup page of the Hub graphical user interface.

Some notes on the SNMP interface and alarms:

- During start-up alarms will be written to the event log, but the fault relay will not set, and no trap will be sent. This start-up period lasts 5 minutes.
- If any alarms remain or any units are still missing once we complete start up, then the Hub will loop through the alarm conditions and send out traps.
- Uplink power under limit alarm is initially set, but then almost immediately cleared when the unit connected to the fiber is deleted from the system. This causes a discrepancy that customers have seen in the dump tables where the dump table is apparently clear, but they have received a trap.

16.4.4. SNMP Settings

To set SNMP items:

1. Click **LAN Setup** in the left navigation bar.
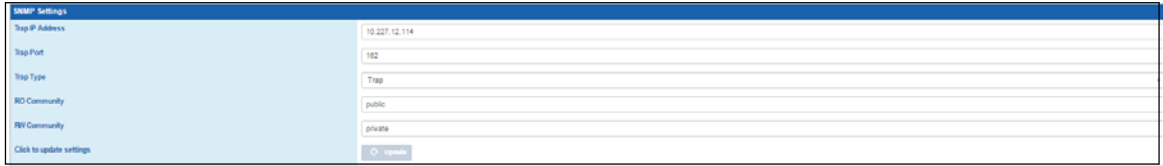
Understanding Alarms and Reporting

2. Enter the Trap IP Address (IPv4) and Trap port number in the SNMP Setting pane.

SNMP Settings	
Trap IP Address	10.227.12.114
Trap Port	162
Trap Type	Trap
RO Community	public
RW Community	private
Click to update settings	Update

The trap IP address is the address to send traps. 0.0.0.0 disables traps. The default trap port is 162.

3. Select the Trap Type (Trap or Inform) from type from the pulldown.

4. Enter the RO and RW Community strings if the default is not desired.

The SNMP Read-Only Community String is like a password. It is sent along with each SNMP Get-Request and allows (or denies) access to device. The default password is "public". Many network administrators change the community string to keep intruders from getting information about the network setup. This is a good idea. Even if it's only read-access, an intruder can learn a lot about a network that could be used to compromise it.

There is also a Read-Write community string. that should never be set to "public". The default is private.

5. Click **Update**.

Chapter 17: Performing Diagnostics and Testing

17.1 Diagnosing Optical Links with an OTDR

The Infrastructure Cable between Hub Optical Module and Remote Unit must meet the following specifications:

- Maximum Optical Loss 5dBo
- Minimum Optical Return Loss 30dB

This can be guaranteed with Singlemode fiber and APC connections throughout the installation.

17.1.1. Diagnose an Optical Link

In presence of high levels of back reflection due to poor Return loss, the Zinwave system performance is degraded. The effects of this can be easily seen on the system and diagnosed using appropriate test equipment. The effects of back reflection can be seen by looking at the level of the noise floor. In cases where there are high levels of back reflection, the noise floor in either the downlink or the uplink can vary significantly (10-15dB). It may also show as increased levels of harmonics which will also vary in level by significant amounts.

The best way to check the return loss of a fiber link is to use an Optical Time Domain Reflectometer (OTDR) with the appropriate connectors and launch cables. A typical graph result is shown below:
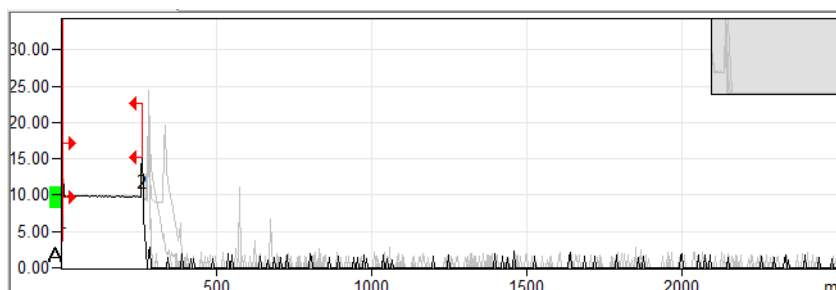
The graph shows the performance of fiber along its length. In this case the first horizontal line represents the first 250m of fiber in the launch box. Each of the subsequent peaks relates to the situations where internal reflection has occurred along the fiber length. This could be connectors, splices or even damaged cables. Generally the highest peak shows the worst case of back reflection and hence source of return loss and potential interference, depending on the OTDR used results, can be displayed in a tabular form giving distances and the relevant reflection or return loss.

Type	No.	Loc.	Loss	Refl.
⌐→	1	0.0000	- - -	-54.3
⊢⊣	(0.2566)		0.088	
⌐Π	2	0.2566	- - -	-39.3

Performing Diagnostics and Testing

In the example above a single reflection of -39.3dB is present. In this case the -39.3dB reflection is at the PC/PC interface at the end of the link and in a link with multiple connections there will be an event for each connection.

It should be noted that the OTDR is not able to distinguish between 2 reflections very close to each other over long lengths of cable and in the case of two reflections close together, only the worst reflection will be shown. However this will allow installers to identify where in the overall fiber link the problem occurs.Available in Left- navigation bar

17.2 LED Testing

17.2.1. Modules

In order to test the proper operation of the module LED's, follow the steps below:-

1. Insert an Optical Module into the front of a Primary Hub.
2. Insert a Service Module into the rear of a Primary Hub.
3. Connect the Optical Module to an Remote Unit.
    The system should be set up with auto-Setup running and all alarms enabled as faults. The following test sequence should be followed:
4. Switch off the Hub at the mains switch
    All module LED's will be off
5. Switch on the Hub at the mains switch
    The Optical Module LED's will follow the sequence shown below:

Left		Middle		Right		Status
	Off		Off		Dull Red	Initial start-up. Basic Power present to allow Module detection
	Off		Off		Green	Module detected and full power connected to module
	Orange		Green		Green	Optical link in calibration
	Green Flash		Green		Green	Calibration complete, but final output stage not enabled
	Green		Green		Green	Fully operational

The Service Module LEDs will follow the sequence shown below:

Left		Middle		Right		Status
	Off		Off		Dull Red	Initial start-up. Basic Power present to allow Module detection
	Off		Off		Green	Module detected and full power connected to module
	Off		Green		Green	Module Fully Operational

6. Disconnect the optical fiber from the Optical Module connector. The Optical Module LED's will alternate between the states shown below:

Left		Middle		Right		Status
⬤	Off	🔴	Red	🟢	Green	Communication failed with Remote Unit
⬤	Off	⬤	Off	🔴	Dull Red	Basic Power present to allow Module detection

7. Wait at least 10 seconds then reconnect the optical fiber to the Optical Module. The Optical Module LED's will follow the same sequence shown in step 2 above.

Note: It is not possible to initiate a module alarm so the left side LED "RED" state cannot be tested.

17.2.2. Remote Unit LED Test

In order to test the correct operation of the Remote Unit LED, connect the Remote Unit to an Optical Module in the front of a Primary Hub. The power supply should not be connected.

The following test sequence should be followed:

1. Power up the Remote Unit by plugging in the power supply
    The LED will follow the sequence:
    OFF – RED – ALT. RED/GREEN – GREEN FLASH – ORANGE – GREEN
2. Using "Hub Setup" disable the Remote Unit output
    The LED will FLASH Hub GREEN
3. Using "Hub Setup" re-enable the Remote Unit output
4. The LED will go GREEN

Note: It is not possible to initiate a Remote Unit alarm, so the RED Secondary Hub state cannot be tested.

17.3 Event Log

Each activity that takes place on this system is recorded as an event. Events can be informational or can generate alarms. For detailed information about alarms See "Understanding Alarms and Reporting" on page 16-1. The last 200 events are saved and recorded in the on-screen event log.

17.3.1. Viewing and saving the Event Log

To view the Event Log:
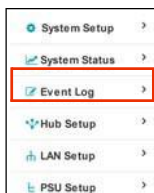
1. Click **Event Log** in the left-navigation bar.

The Event Log is shown.
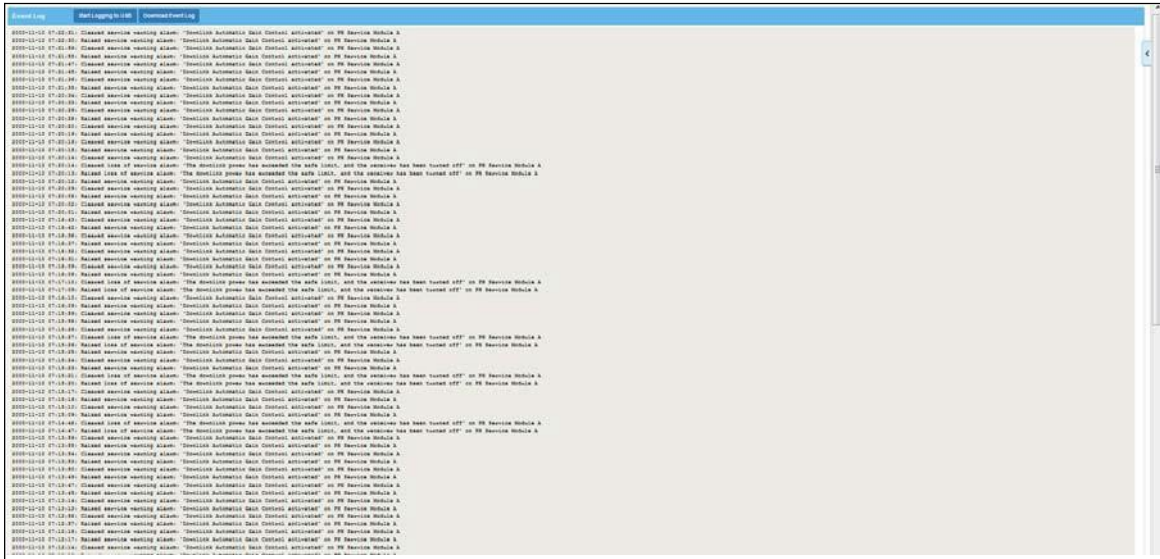
The Event log is also accessible via System Tools. See "View Event Log" on page 13-9.

2. Scroll through the log to see it's details.

3. Click **Download the Event Log** to save the current state of the of the log to a specified location.

Note: Depending on your browser, the file may automatically download to a predetermined location. If this is the case, navigate to the file and move or copy the file as desired.

The file is saved as text files and can be opened in any text editor.

17.3.2. Logging Events to a USB

You can log events to a USB drive. This allows you to record a maximum of 4GB worth of event data. If the event log extends beyond 4GB, logging is disabled. Data sent to the USB is divided into a Raw log and an Event log. The Raw log provides all detailed logging including internal diagnostics and this data may be required for diagnosis. You must setup the file structure on the USB in order for the device to log properly.

To setup the file structure on a USB:

1. On a computer, insert an empty USB with 4GB of storage, into a USB drive.

Note: You cannot configure the USB through the Hub.

2. Add the following folder on the USB drive: **log_event**
Ensure the spelling and capitalization is the same as listed and the underscore appears as listed.

3. Insert the formatted USB into the desired Primary or Secondary Hub.

To log events to a USB dive:

1. Click **Event Log** in the left-navigation bar.
The event log is shown.

2. Insert a formatted USB into the desired Primary or Secondary Hub's USB port.

3. Click **Start Logging to USB**.
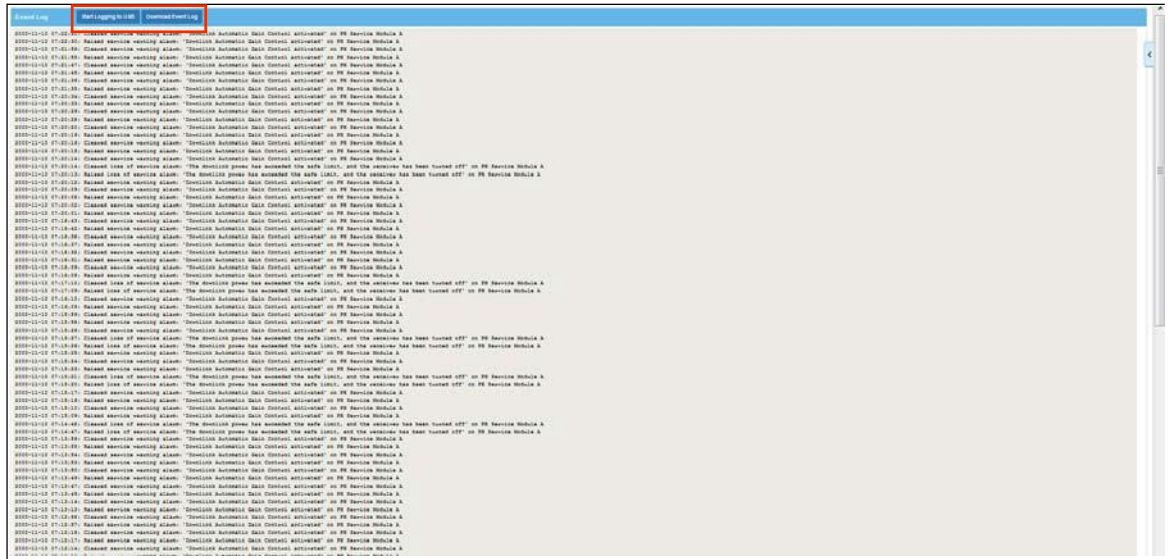
4. When finished logging, click on the **Stop Logging To USB** Event Log screen.

Important: If the USB drive is removed without stopping the logging process, the logging feature will be disabled and can only be re enabled with a Hub reset.

If the correct file structure is not in place on the USB drive the following is displayed in the onscreen Event log when logging is requested.

```
2013-11-28 14:55:28: Stop Storing logs.
2013-11-28 14:55:21: There is no log_event folder on USB.
2013-11-28 14:55:21: There is no log_raw folder on USB.
2013-11-28 14:55:21: Start Storing logs.
```

All log files are .txt files and each file is recorded with the start time and date in the file name. They can be viewed in any text editor.

17.4 Interpreting System Layout Tables

You can view and save a detailed description of the current System layout. This can assist you in isolating system configuration or signal processing issues. Viewing the system layout from a Primary Hub, downloads all information for all configured Secondary Hubs and Remote Units associated with that Primary Hub. Downloading from Secondary Hub, does not show the Primary configuration.

In order to interpret the System Layout files that you save you must:

1. Convert the file to an Excel format.
2. Interpret the Excel sheets.

17.4.1. Converting the System Layout File to Excel

To generate files viewable in the System Layout Tool:

1. View and save the system layout file as described in "View System Layout" on page 13-8.
2. Open the folder for the location to which the file was downloaded.
   The filename will be **system_layout.dmp**.

Name	Date modified	Type	Size
E-mail	New folder		
system_layout.dmp	13/07/2016 15:48	DMP File	60 KB
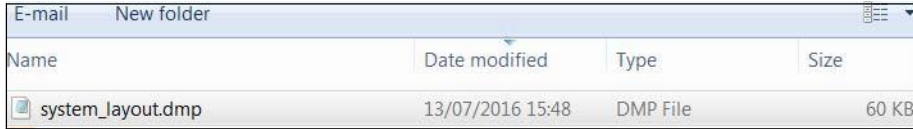
3. Save the file to your desired location.
4. Copy the file **SystemLayout_Gen.xlsm from the USB drive (or zinwave.com) t**o the same location.

Name	Date modified	Type	Size
with ▾	New folder		
system_layout.dmp	13/07/2016 15:48	DMP File	60 KB
SystemLayout_Gen.xlsm	13/07/2016 16:13	Microsoft Excel M...	120 KB
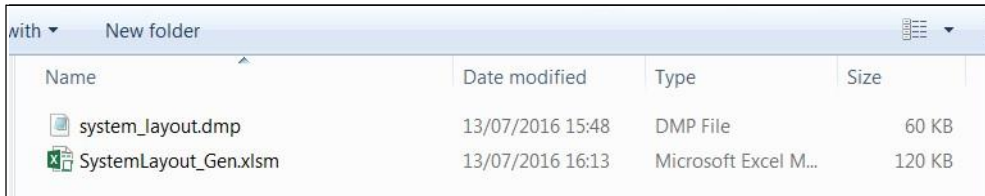
5. Open the Excel file and make sure Macros are enabled.
6. Click the **Run** tab.

	A	B	C	D
		How to Use		
		Copy this file into the same directory as the dump fil		
		Save dump file as .dmp extension and (if available) t		
			Convert Files	
	◂ ▸	**Run**	Template	Autosetup Template ...
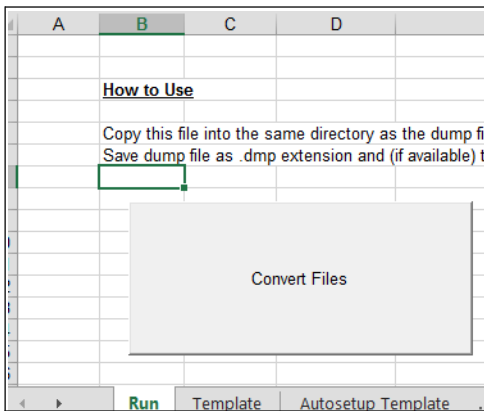
7. Click the **Convert Files** button.
   The Save As window appears.

8. Select the .dmp file to be converted.
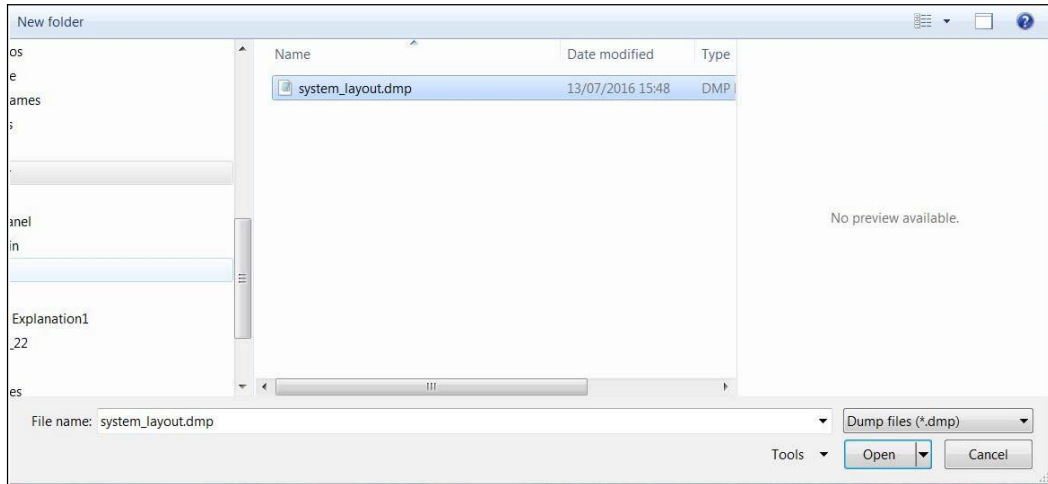
9. Click **Open**.
    A window appears asking for details for a site reference as shown here.
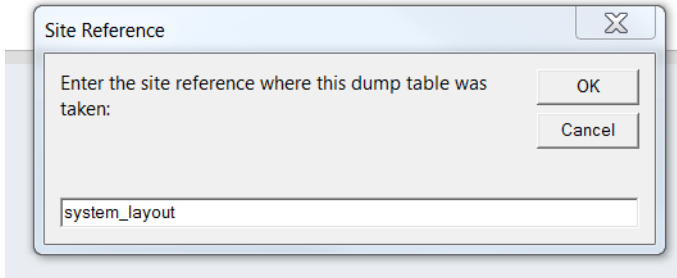
10. Click **OK**.

11. When the confirmation window appears, click **Yes**.
    The file is launched in Excel and is saved as an Excel file in the same location. No closes the tool.
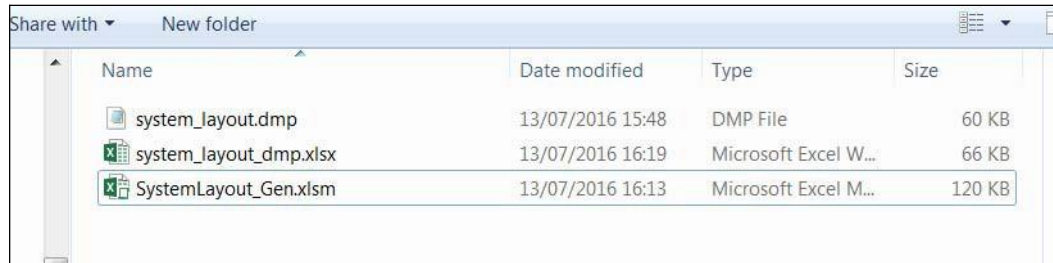
17.4.2. Interpreting the Excel File

The System Layout Tool is an Excel file that has been especially created to help you view the mass quantity of information initially gathered about the currently configured system. The system layout sheet displays all of the data stored for each of the modules and link within the system.

The tool takes the data saved and converted in"Converting the System Layout File to Excel" on page 17-6 and displays it back to you in an organized format in an Excel Workbook consisting of 5 sheets:

- System Layout
- Autosetup
- Link Quality
- Misc
- Tables

After you convert the file, the file is automatically opened. You can return the file at anytime by opening the system_layout_dmp.xlsx file from where you saved it.

17.4.2.1. System Layout Sheet

The system layout sheet displays all parameters of the connected system. This provides a summary of all the data that can be accessed through each module via the System Status page.

You can look at the details listed on this sheet to gather details about the current configuration. The following diagrams zooms in and describes the sheet.

Guideline: Optical loss should be less than 3dB. If the loss is higher it is suggested that fibre quality and cleanliness should be investigated
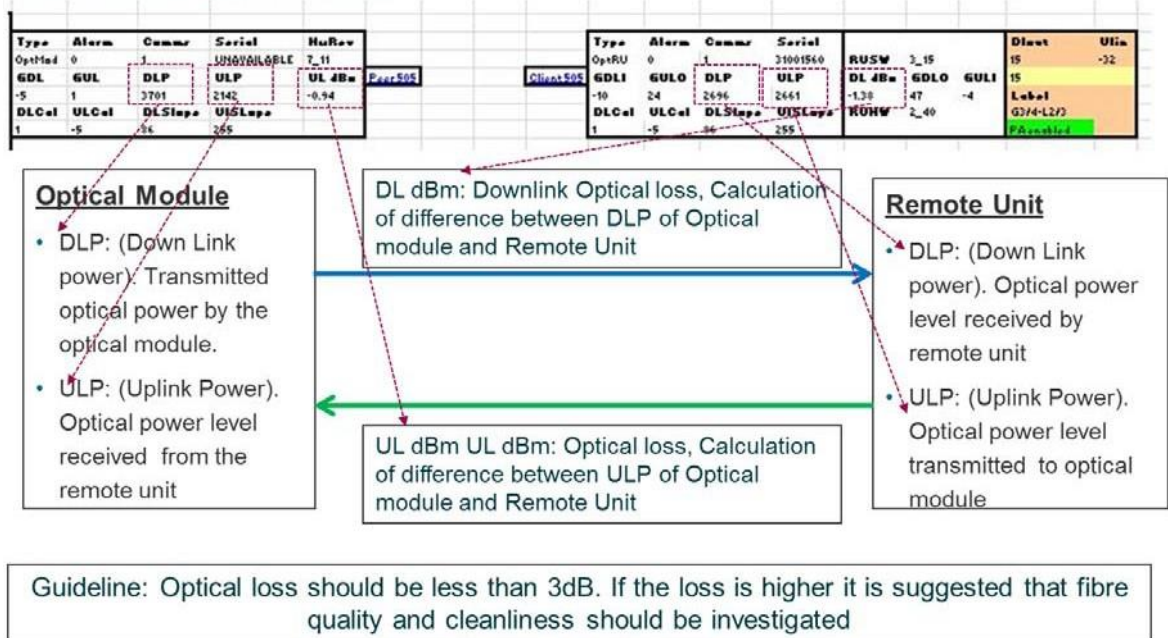
17.4.2.2. Autosetup Sheet

The Autosetup page provides a summary of the information input to set the system up along with details of any warnings or set up errors that may be present in the setup process.

17.4.2.3. Link Quality

The Link Quality tab provides a summary of the optical performance of all links within the system and included individual up and downlink gain and calibration figures.

17.4.2.4. Misc

The Misc tab provides details of the DC power input to each Remote Unit.

17.4.2.5. Tables

The Table tab contains the raw data initially shown on the GUI screen. This data is interpreted and used to display the other tabs.

Chapter 18: Preventive Maintenance and Cleaning

Ongoing maintenance of the system hardware can extend and enhance the life of the system.

Caution: Utilize proper system de-energize and tag-out procedures before completing any maintenance. Incorrect de-energization and tag-out procedure can cause damage or personal injury.

18.1 General Equipment Cleaning and Inspection

Equipment maintenance should be performed in accordance with Manufacturer's instructions. The following are general guidelines for equipment maintenance.

- Wipe component exteriors surfaces (plastic/metal) with a soft lint-free cleaning cloth moistened with a solution of three parts water and one part dishwashing detergent.

Note: Do not soak the cloth or let water drip inside the component.

- Fans, cable connections, cable routing, and other key components should be inspected for degradation.
- Inspect hardware for loose or trampled wires.

18.2 Hardware Maintenance Frequency Guidelines

The Status page of the GUI can be used to monitor the entire system, however regular maintenance should be performed to ensure normal operation.

The following items should be checked:

- General Cleanliness and connections for Rack Mounted equipment
- Fiber Infrastructure and Fibers
- Antenna Cables and Remote Unit Connections

Zinwave recommends the following maintenance guidelines. More frequent maintenance may be needed if the environment is not cleaned and maintained.

	Every 3 Months	Every 6 Months
Perform general cleaning and inspection	X	
Check firmware and hardware updates		X

18.3   General Cleanliness and Rack Mounted Equipment

All rack mounted equipment (Hubs and power supplies) is designed to be installed in dust free and temperature regulated environments.

Every 3 months

- Check for dust ingress and build up and cleaned as appropriate using a soft lint free cloth.
- Fans should be inspected for degradation and excessive noise.
- Cable connections for both power and data should be inspected for degradation, including excessive bending and pinching and damage.

18.4   Fiber Cleaning and Inspection

All fiber connections can be assessed using the Link Quality Tool or through the System Layout tool. All values for loss should be compared to the original installed (handover) values. Any links showing signs of degradation should be cleaned.

18.4.1.   Inspection

The optical fiber connection has two basic performance indicators Insertion loss and Return loss. Poor performance in either of these areas degrade the overall system performance. Physical inspection of all fibers should include checking bend radius of fibers and patch cords as excessive bending will impact both insertion loss and return loss (reflection).

18.4.1.1.   Insertion Loss

The optical loss can be seen for each link by looking at the status page of the web GUI and examining each connection in turn or alternatively making a dump of the entire system data and examining it through the layout tool.

This can be caused by a number of problems (most of which can be resolved simply):

- Incorrectly mated connectors: An incorrectly mated connector will cause either a misalignment of the optical fiber or an air gap between the two ferrule faces. In either case a high insertion loss will be seen.
- Dirty Connectors: dirt on the face of optical connectors will cause higher insertion loss, which can be reduced by careful cleaning of the fibers.
- Poor splice assembly. In some cases infrastructure will include splices. These can, if done poorly, show up as high insertion loss. (They will also cause poor return loss). If the insertion loss is due to a poor splice then it must be remade correctly.

18.4.1.2. Optical Return Loss (Back Reflections)

This is easily tested by using an OTDR instrument, although the symptoms as described above can be seen by looking at the RF output with a spectrum analyzer. The cause of poor back reflections can be caused by:

- Poor or incorrect connector types. APC connectors do not generally produce significant back reflections, but with PC connectors, pay careful attention to the return loss specification and take care when handling connectors to ensure that dirt is not present as it can also effect return loss.
- Tight fiber bends: If a fiber is bent too tightly then it is possible to cause internal reflections. When installing fibers, and particularly when storing excess fiber, always observe the minimum bend radius specified. These are easily seen with a VFL (visual fault locator). These usually use a visible red laser which will clearly show up fiber breaks, severe bends and faulty connectors.
- Dirty fibers (Causing Loss and Back Reflections issues).

18.4.2. Cleaning Fibers

Clean fibers are important in all installations but in Multimode installations this is even more important. Ideally all fibers should be visually inspected as this gives a very clear indication of dirt on fibers.

There are many optical inspection tools such as the one shown below:

Controls

QUICKCAPTURE™ BUTTON
Instantly captures and analyzes fiber image

FOCUS CONTROL

INSPECTION TIP

BARREL ASSEMBLY

USB 2.0 CONNECTOR

LATCH LOCK
Squeeze both ends to release

6 FT COIL CABLE

With the inspection tool shown above which connects to a PC the image of the fiber can be captured and examined prior to cleaning.

Preventive Maintenance and Cleaning

Note that special tips are required to inspect APC connectors due to the angle of the connector face.
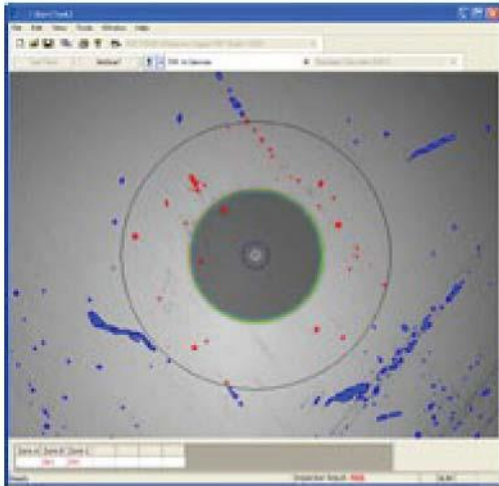
However, the fiber must be clean enough so that <-30dB ORL threshold is maintained on the optical link.

18.4.2.1. Dry Cleaning

This is the most common type of cleaning method. Normally, just a single-click cleaner device is used or the dry cloth. This method is effective for new/better maintained fibers.

18.4.2.2. Wet Cleaning

This method is more effective on used or poorly maintained fibers which require a great deal of cleaning. If the dirt cannot be removed by using dry cleaning methods, special wet wipes, usually alcohol based, can be used to clean the face followed by ideally a dry wipe action such as single-click cleaner to effectively wipe off the dirt speckles.

18.5 Antenna Cables and Connections

Remote Units Antennas and interconnecting jumper cables and connections are normally located behind ceilings and are obscured from sight.

Occasional inspection of cable and antenna physical mounting should be undertaken as part of a coverage or walk test every 6 months.

This should also be done following work being carried out by others in the vicinity of equipment.

Chapter 19: Specifications

System RF Parameters		
System Bandwidth	150MHz to 2700MHz	
System Band Gain Flatness	±1dB	In any 100MHz band
Wide Gain Flatness	-5dB / +1 dB	250MHz to 2700MHz
Downlink		
Gain	25dB (max)	1dB steps
RF Input Power to Service Module	-25dBm (min) to +15dBm (max)	Working input power to Service Module
RF output power at Remote Unit Tx port	+32dBm peak +20dBm/+18dBm RMS	For services approved to FCC/CE regulations
Uplink		
Gain	25dB (max)	1dB steps
RF input level to Remote Unit Rx port	-20dBm	
RF output power from Service Module	-10dBm	Output power of Service Module in Hub
Fiber Optic		
Number of optical ports	Up to 8 duplex ports supported on Primary Hub (Optical Modules); 9 duplex ports on Secondary Hub; 1 duplex port on Remote Unit; SC/APC connectors	
Wavelength	1310nm	
Fiber types supported	Single-mode (SM) cable 9/125 μm	
Fiber distance	5dBo optical link budget, distance dependent on fiber type & quality	
Laser safety classification	Class 1	
Connectivity		
Primary Hub	RF Service connection: 2 N-type female connectors (1 pair per Service Module, maximum 4 Service Modules supported)	
	Optical interconnect (Primary Hub to Secondary Hub, or Primary Hub to Remote Unit): duplex fiber SC/APC connector (1 per Optical Module, maximum 8 Optical Modules supported)	
	10/100Base-T Ethernet connection: 1 RJ45 connector	
	USB2 Host connections: 2 USB type-A receptacles	
	RS232 Serial Terminal: 1 DE-9 male connector	
	Alarm Relay connections: 1 DE-9 female connector	
Secondary Hub	Optical interconnect (connections to 1 Primary Hub and 8 Remote Units): 9 duplex fiber SC/APC connectors	
	Alarm Relay connections: 1 DE-9 female connector	
Remote Unit	RF Antenna connections: 2 N-type female connectors	
	Optical interconnect: duplex fiber SC/APC connector	
	Alarm Relay connector: 1 Phoenix Contact 5.08mm 3-way male	

Specifications

Physical, Electrical, and Environmental	
Primary Hub	17.5" (444mm)w x17.08" (430mm)d x 5.2" (132mm)h (3U) 33.3 lbs (15.10 kg) Fully Populated AC: 110/240V, 50/60Hz, 50-150W (depending on config) Operating temperature (ambient non-condensing) -5 to +45 °C (23 to 113 °F)
Secondary Hub	17.5" (444mm)w x17.13" (435mm)d X 1.72" (43.7mm)h (1U) 15 lbs (6.8 kg) AC input: 110/240V, 50/60Hz, 20-688W (depends on 48V DC output power) DC outputs: 48V, 8 ports, 75W (max) per port Operating temperature (ambient non-condensing) -5 to +45 °C (23 to 113 °F)
Remote Unit	12.12" (308mm)w x 2.63" (67mm)d x 8.6" (220mm)h 5.73 lbs (2.6Kg) 48V DC 0.5A / 24W from Secondary Hub or PSU Operating temperature (ambient non-condensing) -5 to +50 °C (23 to 122 °F)
Central 48V Power Supply	Operating temperature (ambient non-condensing) -5 to +50 °C (23 to 113 °F) 1U dimensions 17.13" (435mm)w x17.3" (440mm)d X1.73" (44mm)h 1U Weight 11.9 lbs (5.4 kg)
POI	Active 17.5" (446mm)w x14.2" (360mm)d X8.8" (222mm)h (5U) 61.7 lbs (28 kg) Fully populated Operating temperature (ambient non-condensing) -40 to +60 °C(-40 to 1140 °F) Small Cell 17.3" (440mm)w x14.95" (380mm)d X1.73" (44mm)h (1U) 2.5 kg (5.5 lbs) Operating temperature (ambient non-condensing) -5 to +45 °C(23 to 113 °F)

Chapter 20: Glossary

Word	Definition
"	Inches
A	Amp
AC	Alternating Current
ALC	Automatic level Control
APC	Angled Physical Contact
AWS	Advanced Wireless Services
BDA	Bi-Directional Amplifier
BTS	Base Transceiver System
BW	Bandwidth
CAT-5	Category 5
CE	Conformity European
Coax	Coaxial
Conditioning Module	A Zinwave hot-swappable module inserted in a POI
Configuration GUI	Zinwave's web-based application
Control Module	A Zinwave hot-swappable module inserted in a POI
DAS	Distributed Antenna System
dB	Decibel
dBc	Decibel relative to carrier
dBm	Decibel referenced to a milliwatt
dBo	Decibel reference to Optical loss / gain
DC	Direct Current
DL	Downlink
EIAJ	Electronic Industries Association of Japan
EMS	Element Management System
EN	European Norm
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FDA	Food and Drug Administration
FDD	Frequency Division Duplex
FSL	Free Space Loss
GHz	Giga Hertz
GSM	Global System for Mobile Communication
HW	Hardware
iDEN	Integrated Digital Enhanced Network

Glossary

Word	Definition
IEC	International Electro technical Commission
ISM	Industrial Scientific and Medical
kg	Kilogram
km	Kilometer
lbs	American measurement in pounds
LED	Light Emitting Diode
LTE	Long Term Evolution
m	Meter
Mains	Refers to AC power
MHz	Mega Hertz
MIMO	multiple-input and multiple-output
mm	millimeter
MM	Multimode
MMF	Multimode Fiber
ms	millisecond
nm	Nanometre
NTRL	National Technical Reports Library
Optical Module	A Zinwave hot-swappable module inserted in a Primary or Secondary Hub
Patch cord	Zinwave provides fiber cables for use with Zinwave Equipment
Passive Module	A Zinwave hot-swappable module inserted in a POI
PC	Physical Contact
PCS	Personal Communications System
POI	Point of Interface, Zinwave has Active and Small Cell devices
Primary Hub	A Zinwave Hub configured as Primary
PSU	Power Supply Unit (1U and 2U available)
Remote Unit	A Zinwave device that connects to an antenna
RoW	Rest of World
RF	Radio Frequency
RJ45	Registered Jack 45
Rx	Receive
SC-APC	Standard Connector/ Angled Physical Contact
Secondary Hub	A Zinwave Hub configured as Secondary
Service Module	A Zinwave hot-swappable module inserted in a Primary Hub
SM	Singlemode
SMA	Subminature Version A
SMF	Singlemode Fiber
SMR	Specialized Mobile Radio
SNMP	Simple Network Management Protocol

Word	Definition
TDD	Time division duplex
Tma	Maximum ambient temperature
Tx	Transmit
UL	Uplink
UMTS	Universal Mobile Telecommunications System
UNItivity 5000	Zinwave's in-building wireless solution
V	Volt
VAC	Volts Alternating Current
W	Watts
WCDMA	Wideband code division multiple access
Wi-Fi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local area network
μm	Micron, $1x10^{-6}$ meters

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