ARCXtend™ Wireless Plant Extension Solution

5.8 GHz Operation

User Manual

R1.0 Issue 1

P/N: Preliminary

Arcwave, Inc.
910 Campisi Way, Suite 1C,
Campbell, CA 95008 USA,
Phone: 408-558-2300
www.arcwaveinc.com

REVISION HISTORY

ISSUE #	AUTHOR	CHECK OUT	CHECK IN	COMMENTS
1.0	CM		08/29/2005	

NOTICES

The information in this publication is subject to change without notice. Arcwave shall not be liable for technical or editorial errors or omissions nor for any damages resulting from the use of this material.

Each configuration tested or described may or may not be the only available solution. This test is not a determination of product quality or correctness, nor does it ensure compliance with any federal, state or local requirements. Arcwave does not warrant products other than its own strictly as stated in Arcwave's product warranties.

U.S. Federal Communication Commission (FCC) Notification

This device complies with part 15 of the U. S. FCC Rules and Regulations and with is subject to the following 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 equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the U.S. FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

Increase the separation between the affected equipment and the unit;

Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;

Consult the dealer and/or experienced radio/TV technician for help.

Part 15, Section 15.21 Warning

Changes or modifications not expressly approved by Arcwave, Inc. could void the user's authority to operate the equipment. FCC IDs Numbers are listed below:

FCC Identifier: TBD

RF Safety Warning:

To insure compliance with FCC recommended General Population/Uncontrolled exposure limits the ARCXtend Hub and CPE must be installed a minimum of one foot from areas frequented by the general population.

To insure compliance with FCC recommended Occupational/Controlled exposure limits, field engineers and technicians should maintain a minimum working distance of six inches, as measure from the front of the units to the front of their bodies, from the front of the Hub and CPE. For working distance inside six inches, RF exposure should be limited to an average of 30 minutes at a time. All Arcwave equipment, however, has been designed to allow installation and maintenance at a range well within FCC RF exposure levels.

For further information, please refer to:

http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf.

http://www.arcwaveinc.com

TABLE OF CONTENTS

FIGURES

TABLES

INTRODUCTION

About this Document

Purpose

Proper installation and verification are critical elements to achieving optimal wireless performance. This document provides cable plant installation professionals with information needed for successfully deploying and maintaining Arcwave's ARCXtend Wireless Plant Extension Solution.

Action items in this document preceded with by the ☞symbol.

Audience

This document is designed to be used by cable plant installation professionals. It can be performed by one person with the proper training, wireless link planning, and tools. It is recommended, however, that two people be present during the alignment process between the ARCXtend Network Hub (Hub) and ARCXtend CPE (CPE): one person located at the Hub and the other at the CPE.

Prerequisites

Professionals using this process should be trained and familiar with installation and troubleshooting of cable drops, cable modems, and ARCXtend.

Feedback

We welcome your feedback on Arcwave documentation. This includes feedback on structure, content, accuracy, or completeness of our documents, and any other comments have. Please send your comments to marketing@arcwaveinc.com.

PRODUCT DESCRIPTION

Overview

The ARCXtend solution is a wireless point-to-multipoint plant extension solution supporting the wireless transmission of digitally modulated RF signals between a cable system operator's coaxial cable plant and one or more customer sites. The solution consists of a Strand or Vertically Mounted Network Hub (Hub) and one or more Customer Premise Equipments (CPE). The Hub connects directly to the coaxial portion of cable plant using a standard power passing, passive tap or coupler and is line powered over coax using 60-90 Vac. The CPE is installed at the customer site, connects to a standard cable modem, and is powered locally using an AC power pack.

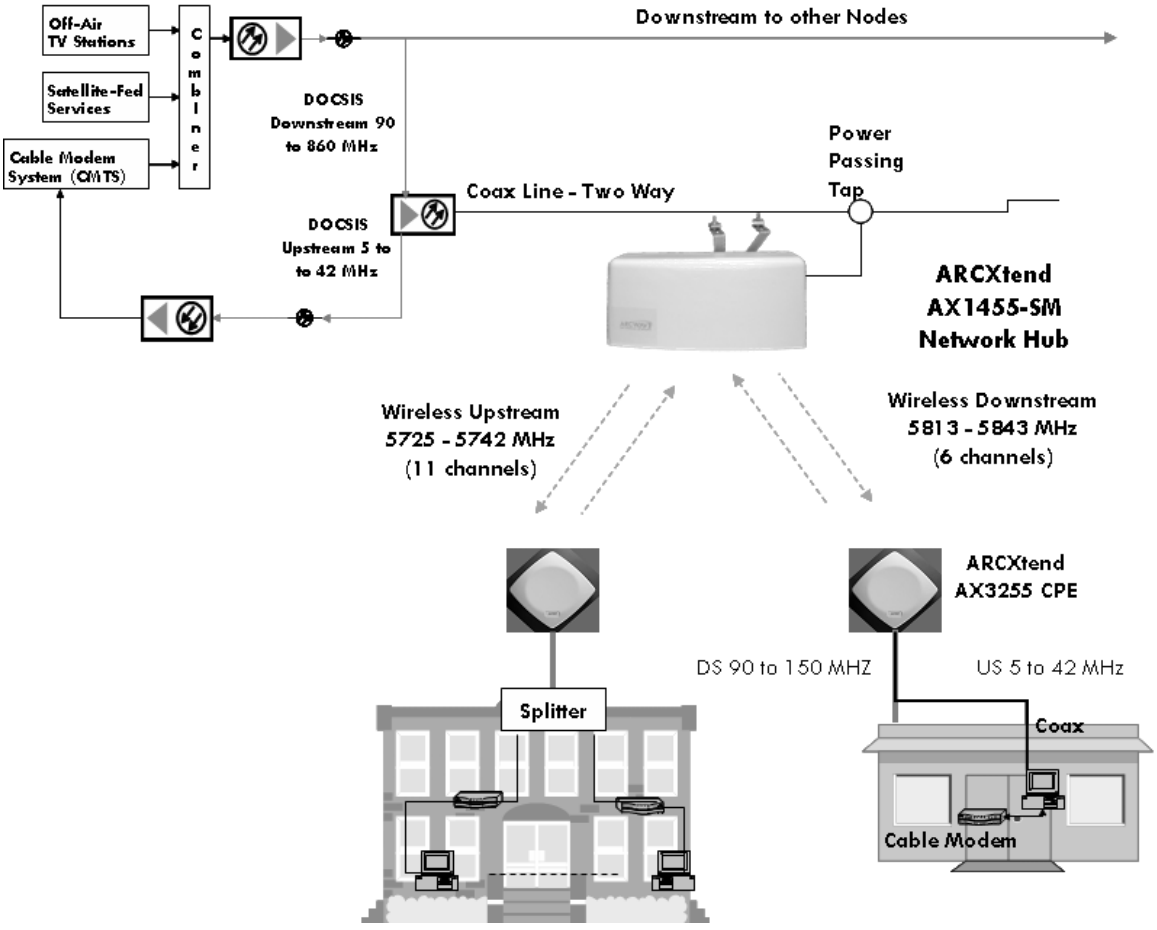


Figure 2-1: ARCXtend Solution Architecture

System Configuration

Figure 2-2 details the elements of the ARCXtend solution provided by Arcwave (shaded) and provided by the cable operator:

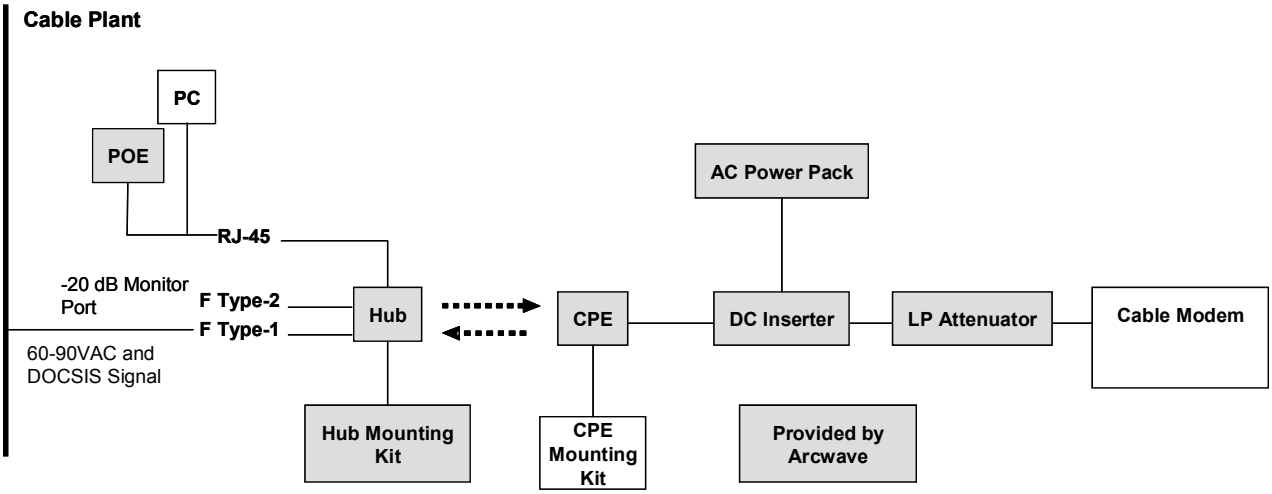


Figure 2-2: ARCXtend Solution Elements

Cable and Wireless Network Interfaces

Frequency Mapping

The Hub receives a digitally modulated RF signal in the range between 90 and 860 MHz to and up converts it to one of the six available wireless carriers in the range 5.8 GHz license-free band. The channel can be 64 QAM or 256 QAM and up to 6 MHz wide.

The CPE receives the wireless signal and down converts it to an RF channel in the range 90 to 150 MHz which is provided to a Cable Modem.

The CPE receives a digitally modulated RF signal in the range between 5 to 42 MHz and up converts it to a fixed frequency in the range 5.8 GHz license free band.

The Hub receives the wireless signal and down converts it to the appropriate RF channel in the range 5 to 42 MHz.

Signal Levels

The Hub includes Automatic Gain Control (AGC) on the RF input and can accept an RF input signal of 0 to +30 dBmV while providing optimum wireless transmit power. The hub wireless transmitter power, determined by the **Downstream Transmit Power** setting, can be set for on of three modes: High, Medium or Test mode.

Note: The “High” power setting is for use with the AX1455-SM-Network Hub. Use of the “High” power setting with the AX1455-SM-25 cancels the FCC certification and voids the user’s authority to operate the unit in the 5.8 GHz band.

The upstream output power out of the Hub into the cable plant is controlled by the **Upstream Attenuation** parameter. This parameter is automatically set by the Hub based on the transmit power setting of the Embedded Cable Modem (ECM) contained in the Hub.

The gain of the CPE is fixed in both the upstream and downstream direction. The transmit power of the CPE directed towards the Hub will vary based on the input RF signal received from the cable modem. The CPE can accept an input RF signal between 20 and +58 dBmV from a cable modem. The downstream output power out of the CPE directed towards the cable modem will vary based on the distance between the Hub and the CPE. It is typically in the range of +10 to +30 dBmV. Arcwave provides specially designed low pass attenuators to reduce the downstream power level to within the – 15 dBmV and +15 dBmV operating range of a cable modem. Note that for 256 QAM the downstream power level into the cable modem must be at least -6 dBmV.

Element Management

Each Hub contains Arcwave's ARCSmart intelligent network management which combines an embedded DOCSIS 2.0 compliant cable modem, SNMP-compliant Arcwave Enterprise MIB (management information base) and a processing engine with upgradeable software to support low cost configuration monitoring, and troubleshooting of a Hub.

Management of the CPE can be most cost effectively achieved using the capabilities built into the subscriber cable modem. The CPE has no settable parameters so management is not required.

Applications

ARCXtend Wireless Drop

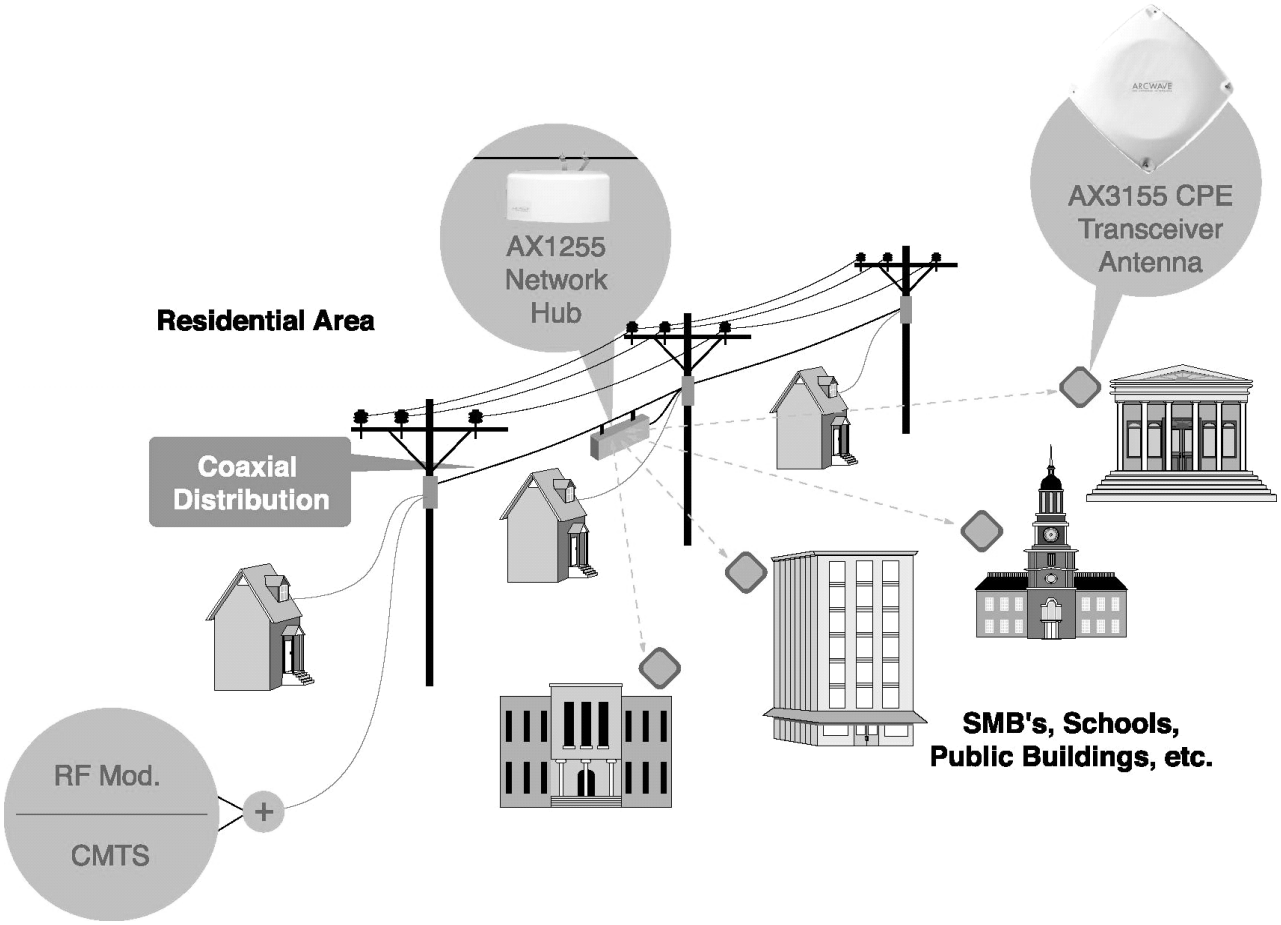


Figure 2-3: Wireless Drop

ARCXtend can be deployed as a wireless drop connecting customers located across a parking lot, highway, or river or in areas with zoning restrictions to your plant. An AX1455-SM strand mount hub mounts directly on the cable plant.

Wireless Overlay and Upstream

The ARCXtend Wireless overlay solution delivers additional DOCSIS capacity without costly network upgrades or deployments. It is an ideal solution for providing DOCSIS-based services to isolated communities or out-of-franchise markets. A typical ARCXtend cell site, mounted on 100 foot tower, can cover over 100 square miles and could provide commercial-grade high speed data service for up to 1,600 customers.

The ARCXtend Wireless upstream solution provides a quick and cost effective means for upgrading older one-way plants to deliver 2-way DOCSIS service. With the ARCXtend wireless upstream solution, two-way service can be up and running in weeks rather than months at a fraction of the cost of upgrading the entire plant.

Equipment Description

ARCXtend Network Hub

The Hub is a self-contained weather-protected unit providing a 2-way wireless connection between a CMTS or cable plant and a cable modem. The Network Hub includes an integrated transceiver, antenna, embedded cable modem and controller supporting high reliability point-to-multipoint wireless coverage, SNMP, HTTP-based web user interface, ARCSmart Intelligent network management, and PureBurst upstream ingress noise suppression technology.

- ARCSmart is a fully programmable and field upgradeable engine that enables a Network Hub to dynamically optimize itself to changing DOCSIS or Wireless Network conditions.
- PureBurst enables Cable MSO's to send an upstream DOCSIS channel over wireless links with zero impact to their cable network.

The Hub is frequency agile from 90 to 860 MHz and can be connected directly to a cable plant using a common tap or coupler. It can be mounted on the cable strand or on a tower, building or other nearby structure and can be line or locally powered.

Hub Interfaces

The Hub has the following interfaces and indicators as shown in Figure 2-5 and described below:

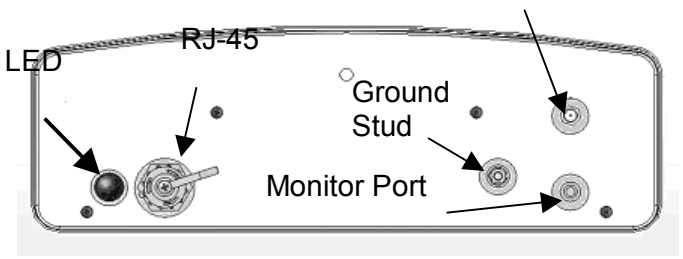


Figure 2-5 AX1455-SM (on left) and AX1455-VM Connectors (on right)

RF Input Port: AC surge protected and SCTE compliant female F-type connector for RF and power connection to the cable network.

-20 dB Monitor Port: SCTE compliant female F-type connector for monitoring the upstream RF signal.

Weather-proof Ethernet Port: RJ-45 connector for local connection of a PC and for Vdc powering over Ethernet (PoE).

Pin	Function	US modern T-568A
1	Ethernet Tx+	green-white
2	Ethernet Tx-	green
3	Ethernet Rx+	orange-white
4	PoE - lower voltage (+)	blue
5	PoE - lower voltage (+)	blue -white
6	Ethernet Rx-	orange
7	PoE - higher voltage (-)	brown-white
8	PoE - higher voltage (-)	brown

Table 2-1: Table for 10/100 Mbits Ethernet wiring and Power over Ethernet

Power-on, LED: Indicates that the Hub is receiving Vac or Vdc power. (AX1455-SM Only)

Hub Configurations

The Hub model number format is AX1UV5-WW-XX where:

- "U" indicates frequency band(s) of operation where "2" is for 5.8 GHz downstream and 5.3 GHz upstream operation and "4" is for 5.8 GHz only.
- "V" is "0", for Upstream Only, or "5", for Bidirectional
- "WW" indicates mounting orientation, VM, for Vertical Mount, or SM, for Strand Mount).
- "XX" indicates antenna transmit beam width (i.e. "90", for 90-Degree horizontal beam width. "60", for 60-degree horizontal beam width and "25", for 20-Degree horizontal beam width).

All Hubs support both 60 to 90 Vac powering over coax and 24 Vdc powering over Ethernet (POE). The standard network hub configurations are:

Model number	Downstream Frequency Band	Upstream Frequency Band	Mounting Orientation	Transmit Antenna Beam width	Downstream Range		
					64 QAM	256 QAM	
Bidirectional Systems							
AX1455-SM-60	5813– 5843 MHz	5725 - 5742 MHz	Horizontal	60 Degrees	1 Mile	½ Mile	
AX1455-SM-25	5813– 5843 MHz	5725 - 5742 MHz	Horizontal	20 Degrees	2 Miles	¾ Mile	
Upstream Only, No remote monitoring. If remote monitoring is desired use a standard AX1455-VM-90.					QPSK	16 QAM	64 QAM
AX1405-SM-60		5725 - 5742 MHz	Horizontal	60 Degrees	8 Miles	4 Miles	2 Miles

Table 2-2: Hub Configurations

Hub Mounting Kits

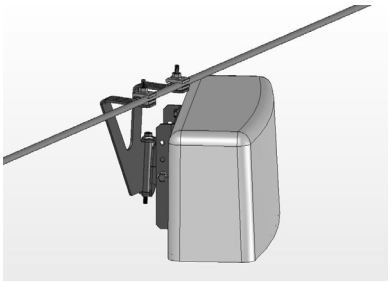
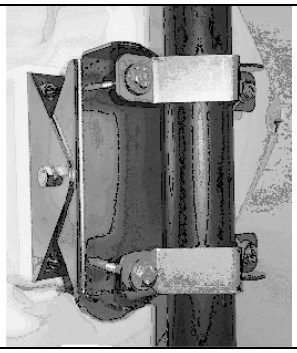
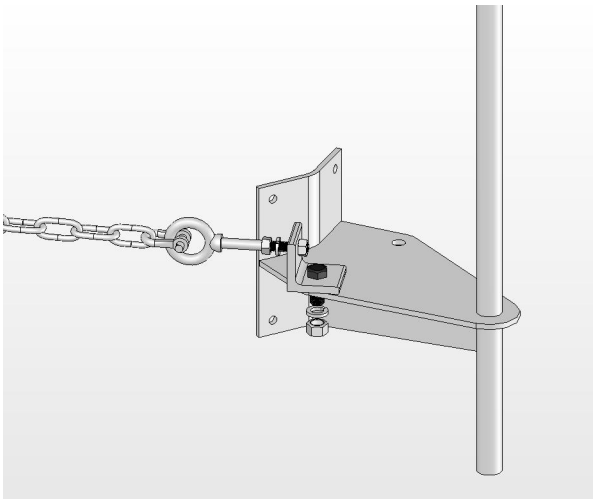
Works with	Model	Description	Image
AX1455-SM	Standard	ARCXtend Strand Mount Kit Used to mount an AX1455-SM to a standard strand cable Includes integrated mounting bracket providing 360° vertical and +/- 30° horizontal adjustment for rapid and flexible antenna alignment.	
	AX1455-SMA	ARCXtend Strand Mount Adaptor Kit, Network Hub Used to mount an AX1455-SM in the horizontal position on a 1-1/4 to 2-3/8 O.D. pipe mount	
	AX1455-PMK	ARCXtend Pole Mount Kit, Network Hub Includes the AX1455-MMK Enables the Hub to be mounted to a standard diameter wooden utility pole using a chain or four bolts The Hub attaches to a pile welded to the bracket using the mast mount kit	

Table 2-3 Hub Mounting Options

ARCXtend CPE

The CPE is small footprint weatherproof radome that can be easily mounted on a rooftop or side of a building to provide connectivity to the wireless network. It contains an integrated transceiver and a narrow-beam antenna that can be easily aligned to receive the Wireless DOCSIS signal from a Network Hub. The CPE is roughly one foot square and supports low cost installation using the same hardware and skills as a small satellite dish.

The CPE has a single, female-type F connector for both Vdc power and RF signal. It is located on the back of the unit as show in Figure 2-6.

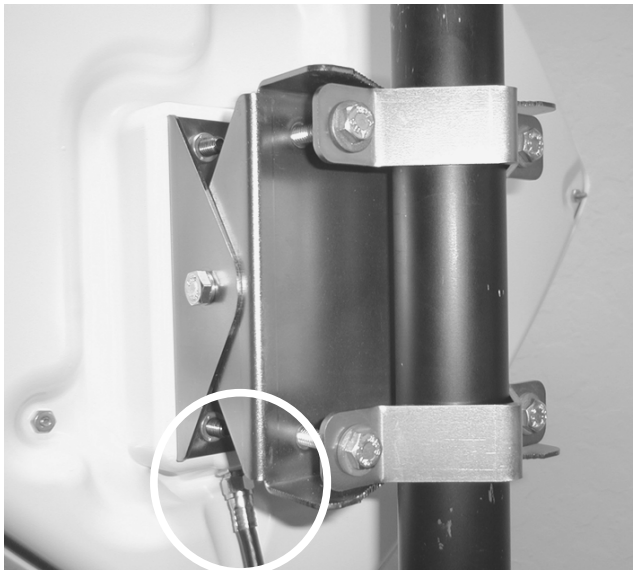


Figure 2-6: CPE RF Connector

CPE Configuration and Accessories

The CPE model number format is AX3U55-WW-XX where:

- "U" indicates frequency band(s) of operation where "2" is for 5.8 GHz downstream and 5.3 GHz upstream operation and "4" is for 5.8 GHz only.
- "WW" indicates mounting orientation, VM, for Vertical Mount, or SM, for Strand Mount).
- "XX" indicates antenna transmit beam width ("90", for 90-Degree Horizontal beam width).

The standard CPE models are:

Model number	Downstream Frequency Band	Upstream Frequency Band	Mounting Orientation	Transmit Antenna Beam width	Upstream Range		
					QPSK	16 QAM	64 QAM
AX1455-VM-90	5813– 5843 MHz	5725 - 5742 MHz	Vertical	90 Degrees	8 Miles	4 Miles	2 Miles

Table 2-4: CPE Models

The standard CPE accessories are:

Power Packs and DC Inserters

- AX1455-PS-18: 120 Vac 60 Hz/18 Vdc adaptor and DC Inserter

Downstream Signal Attenuators

- AX32155-ECF-10: 10 dB Downstream Attenuator for attenuating the DS signal level without affecting the US signal level
- AX1455-ECF-20: 20 dB Downstream Attenuator for attenuating the DS signal level without affecting the US signal level.

ARCSmart™ 2.1 Intelligent Network Management

Arcwave's ARCSmart intelligent network management combines an embedded DOCSIS 2.0 compliant cable modem, SNMP-compliant Arcwave Enterprise MIB R2.1 (management information base), and an upgradeable processing engine with upgradeable software to support low cost configuration, monitoring, and troubleshooting of an ARCXtend Network Hub (Hub). Specific capabilities include:

- DOCSIS 2.0-compliant embedded cable modem (ECM)
- SNMP-compliant Arcwave Enterprise MIB
- HTTP-based User Interface
- ARCSmart firmware upgrade

DOCSIS 2.0 Compliant ECM

Each Hub includes a hardened DOCSIS 2.0-compliant cable modem (ECM) supporting in-band communication over standard DOCSIS channels with ARCSmart. For proper operation of ARCSmart Advanced Network Features the ECM and all cable modems served by the Hub must be on the same downstream and upstream DOCSIS channels at all times.

The ECM firmware can be upgrading using TFTP and normal cable modem firmware upgrade procedures.

Watchdog Timer

This embedded cable modem also includes a system watchdog timer with a peripheral bus interface. It provides a method for resetting the host, upon expiration of the timer value, to heal system hangs due to software bugs, power spikes, and so on. The watchdog timer period and pre-scale values are programmable and are protected by dual keyed-lock state machines. Disabling of the watchdog timer is protected by both hardware tie-offs and a triple keyed-lock state machine. Resetting (kicking) of the watchdog timer is provided through a dual keyed-lock state machine.

SNMP-compliant Arcwave Enterprise MIB

The Arcwave Enterprise MIB is compliant with SNMP version 1, 2, and 3 and fully accessible and manageable using third-party SNMP-based network management tools. It contains all Hub management, performance, and configuration data. Appendix A of this manual contains a description and element definitions for the Arcwave Enterprise MIB as implemented in the Hub. The compilable “arcwave.mib” file is included on each product documentation CD and can also be downloaded from the Support section of the Arcwave website, www.arcwaveinc.com.

Setting the SNMP public and private strings

For the SNMP Community String (Private), Read-Write Access set the following MIB to the indicated value as show in Table 2-5:

DOCSIS MIB Name	Object ID	Type	Value
docsDevNmAccessStatus	1.3.6.1.3.69.1.2.1.7.1	Integer	4
docsDevNmAccessIp	1.3.6.1.3.69.1.2.1.2.1	IpAddress	255.255.255.255 (means any NMS station)
docsDevNmAccessIpMask	1.3.6.1.3.69.1.2.1.3.1	IpAddress	0.0.0.0
docsDevNmAccessCommunity	1.3.6.1.3.69.1.2.1.4.1	OctetString	private (the name you want)
docsDevNmAccessControl	1.3.6.1.3.69.1.2.1.5.1	Integer	3

Table 2-5 SNMP Community String (Private), Read-Write Access

For the SNMP Community String (Public), Read-Write Access set the following MIB to the indicated value as show in Table 2-6 Read-Only Access:

DOCSIS MIB Name	Object ID	Type	Value
docsDevNmAccessStatus	1.3.6.1.3.69.1.2.1.7.1	Integer	4
docsDevNmAccessIp	1.3.6.1.3.69.1.2.1.2.1	IpAddress	255.255.255.255 (means any NMS station)
docsDevNmAccessIpMask	1.3.6.1.3.69.1.2.1.3.1	IpAddress	0.0.0.0
docsDevNmAccessCommunity	1.3.6.1.3.69.1.2.1.4.1	OctetString	public (the name you want)
docsDevNmAccessControl	1.3.6.1.3.69.1.2.1.5.1	Integer	2

Table 2-6 SNMP Community String (Public), Read-Write Access

HTTP-based user interface

The Hub contains an HTTP-based web tool that can be used to interface to the unit.

ARCSmart firmware upgrade

ARCSmart provides the ability to upgrade its firmware using a TFTP (Trivial File Transfer Protocol) protocol. This is accomplished using the Firmware Download Information table on the Arcwave MIB Maintenance page:

TFTP server IP Address: Enter the TFTP (Trivial File Transfer Protocol) server's IP address.

Firmware Upgrade Filename: Enter the file name of the ARCSmart controller firmware to be downloaded to the Hub.

Start Upgrade: Click the "Apply" button to initiate the download. The download of the new controller firmware will take one to two minutes. The download can be verified by refreshing the page. The version number of the downloaded firmware should be displayed in the Firmware Version Number box under in the Real Time Monitor Information table.

Advanced Network Management Features

Plug-n-Play

ARCSmart has the ability to automatically program and modify Hub settings with the same DOCSIS downstream and upstream channel information being received by the ECM. To activate this feature, set **Auto Frequency Set** to "ENABLE". With this activate, whenever the ECM detects a change in the downstream or upstream channel it will propagate this change to the appropriate Hub settings. This includes information sent in a Station Maintenance Message (SMM) Notification-US Frequency Change.

Downstream frequency agility

ARCSmart has the ability to automatically "tune" to a downstream channel on the cable network. To activate this feature, set **Cable Interface Control** to "On".

Settable Hub Transmit Power

The wireless transmitter output of the Hub, determined by the **Select Downstream Power** setting, can be set for on of three modes: High (high power), Medium (high linearity) or Test (short range)

Note: The "High" power setting is for use with the AX1455-SM-60 Network Hubs. Use of the "High" power setting with the AX1455-SM-25 cancels the FCC certification and voids the operator's authority to operate the unit in the 5.8 GHz band.

PureBurst Ingress Noise Suppression

PureBurst effectively functions as a door. When there is no wireless upstream signal being received by the Hub, this door is closed. When closed, the Hub does not output any noise onto the cable plant. Therefore, when other subscribers are transmitting in the upstream to the CMTS, the wireless hub does not contribute to the cable plant's noise floor.

When a cable modem utilizing the wireless upstream link is transmitting the door is open. During this time the Hub allows the upstream signal plus Hub related thermal noise to pass onto the cable plant. Closing of the door results in the cable plant's U/S noise floor returning to its previous level. This ensures that the only upstream signal affected by the hub's internal upstream noise is the wireless burst signal as scheduled by the CMTS. This allows many wireless hubs employing PureBurst to be connected to the same cable plant without raising the upstream plant noise floor and affecting other users sharing the same cable plant.

This feature is enabled by default.

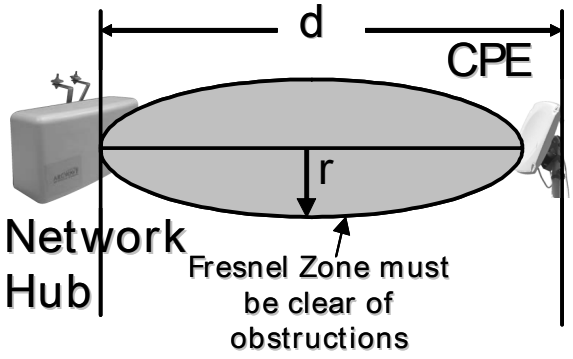
PRE-DEPLOYMENT PLANNING

Hub Site Selection

A suitable location for the Hub is one that provides an acceptable line of sight (LOS) wireless link to the CPE(s) located at the customer site(s). An acceptable wireless link is one within the working range of Hub and with line of sight to the customer sites.

Line of Site

Line of sight is defined as a path between the Hub and CPE that is free of obstructions in the Fresnel zone. Obstructions could be trees, buildings, street signs, etc. An accepted rule of thumb is that LOS conditions exist when there are no physical obstructions within 60% of the Fresnel zone (obstruction free zone). Obstructions can be trees, buildings, street signs, etc. The Fresnel Zone clearance is determined by the distance between the Hub and CPE as shown in Figure 3-1.



d	500 ft.	1,000 ft.	½ mile	1 mile	2 miles
r	3 ft.	4 ft.	6 ft.	9 ft.	12 feet

Figure 3-1: Fresnel Zone Clearance Requirement

Range

The maximum range, assuming a clear Fresnel zone, is determined by the Hub type, downstream modulation, and the mounting height of the Hub. The range, arc, and coverage area of all models of Hubs are given in Tables 3-1 and 3-2.

Table 3-1: AX1455-SM-60 Strand Mounted Network Hub (18 ft off the ground)

Modulation	Range	Arc	Area
Downstream Wireless Link			
64 QAM (DS)	2 miles	3.1 miles	3.14 sq-miles
256 QAM (DS)	¾ mile	0.3 miles	0.13 sq-miles

Table 3-2: AX1455-SM-25 Strand Mounted Network Hub (18 ft off the ground)

Modulation	Range	Arc	Area
Downstream Wireless Link			
64 QAM (DS)	2 miles	3.1 miles	3.14 sq-miles
256 QAM (DS)	½ mile	0.8 miles	0.19 sq-miles

Equipment Location

A simple method for choosing the location of the Hub uses a map[1] of the area to be covered. Draw two circles taking the customer site(s) to be covered as its center and the maximum range of each Hub type as the circle's radius. .

Once you have identified possible sites for the Hub, drive out to these locations and determine which, if any of them, provide a line of site path to the customer site(s) to be served. The simplest way to do this is, using a spotting scope, find the other end of the path and determine if it meets the Fresnel zone criteria. A more accurate approach would be to use a range finder to measure the height of the highest obstruction in the path and GPS to measure the distance. If you find that none of the Hub sites will work then you need to go back to the map and try and locate alternative locations.

Checking for Upstream Interference

ARCXtend maps the upstream DOCSIS channel to a frequency between 5,725 MHz and 5,742 MHz. As shown in Table 3-3 the mapping is fixed and based solely on the frequency of the upstream DOCSIS channel.

Upstream DOCSIS Channel	Upstream Wireless Channel	Upstream DOCSIS Channel	Upstream Wireless Channel
center (MHz)	center (MHz)	center (MHz)	center (MHz)
10.2	5730.2	29.4	5749.4
13.4	5733.4	32.6	5752.6
16.6	5736.6	35.8	5755.8
19.8	5739.8	39.0	5759.0
23.0	5743.0	42.2	5762.2
26.2	5746.2		

[1] A network map with street and building information is ideal for this activity.

Table 3-3: Upstream Channel Mapping

The upstream wireless channel is centered at 5,720 MHz plus the upstream DOCSIS channel frequency: e.g. Upstream Channel 29.5 MHz is transmitted at 5,749.5 MHz.

As part of the site selection process check for interference at the wireless frequency carrying the DOCSIS upstream channel. If interference is present you will need to use a different DOCSIS upstream channel, if possible, or move the Hub to a different location. .

Handheld wireless LAN spectrum analyzers covering the 5.250 to 5.350 range and capable of identifying signals regardless of origin, like the BANTAM INSTRUMENTS Model 425A, are ideal for locating potential interference.

CPE Site Selection

Height and Location

A suitable location for the CPE is one that provides an acceptable line of sight (LOS) wireless link, as previously defined, to the Hub. This requires the CPE to be placed high enough on the rooftop to provide the required Fresnel zone clearance. Using the setup shown in Figure 3-2, the optimal height and location can be determined by monitoring the Signal Level reading on the AR100 Signal Strength Meter. Monitoring the Signal Level meter on the AR100, the optimal CPE height and location will be indicated by maximum signal level readings.

The CPE should be located to the edge of the building closet to the Hub. If the CPE were to be mounted towards the middle or back of the building, the incoming wireless signal can be reflected by the rooftop impairing the performance of the link. It is also advisable to select a location near to the rooftop grounding system to have a short, low resistance path and within 300 feet of an AC power source. The routing path for the coaxial cable that connects the CPE to the cable modem is also worked following your normal guidelines.

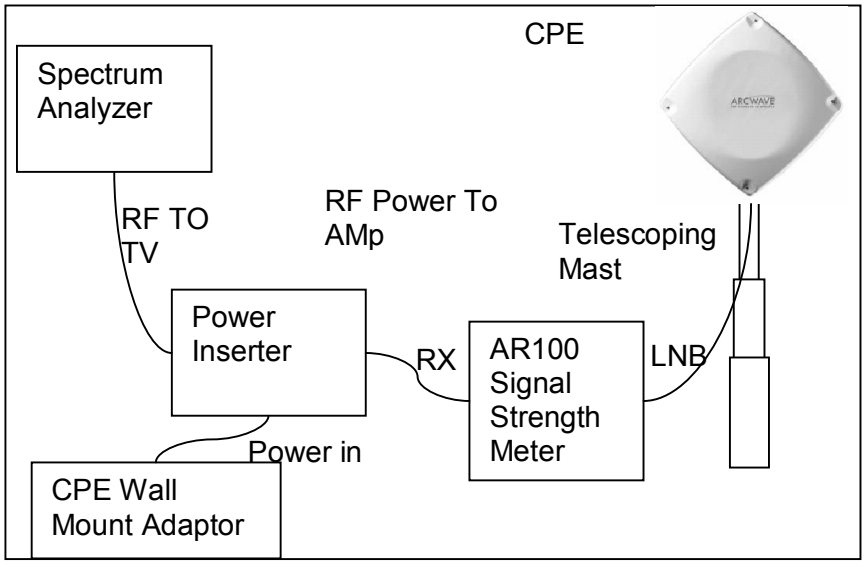


Figure 3-2: CPE Site Survey Setup

Checking for Interference

ARCXtend supports the assignment of any downstream RF channel to one of the twenty available downstream wireless channels. The available carriers and the corresponding CPE downstream RF channel are given in Table 3-4. By examining the CPE downstream frequency spectrum we can determine which of the wireless channels is free of interference.

Hub Downstream Wireless Carrier Channel	CPE Downstream RF Channel
5813 MHz	99 MHz
5819	105
5825	111
5831	117
5837	123
5843	99 MHz

Table 3-4: Downstream Hub to CPE Channel Mapping

Channel Plan

Downstream Configuration

The ARCXtend downstream block diagram is illustrated in Figure 3-3. Note that the North American DOCSIS 64 QAM or 256 QAM downstream signal is 5.25 MHz wide and is transported within a standard 6 MHz wide channel throughout the CATV plant and the ARCXtend system. All downstream frequencies indicated are the center frequency of the 6 MHz wide channel.

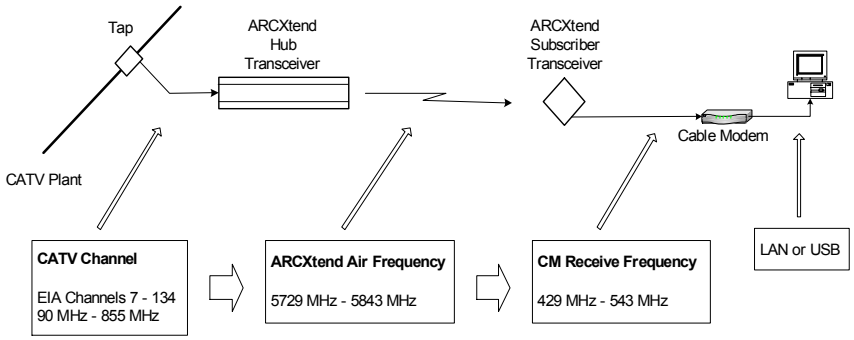


Figure 3-3: ARCXtend Downstream Block Diagram

Downstream Block Diagram

The DOCSIS cable modem downstream channel on the CATV plant is already established in the working cable modem system. At the time of installation the ARCXtend Hub is automatically configured to the CATV downstream channel. Any EIA channel between 7 and 134, inclusive, may be utilized. Table A-4 in Appendix A provides a list of these channels and their corresponding center frequencies.

The Downstream DOCSIS channel can mapped to any one of the available downstream wireless frequencies. Each downstream wireless channel is down converted by the CPE to a fixed frequency as given in Table 3-4. e

In summary, any CATV downstream channel may be employed as input into the Hub, and any specified air frequency between 5729 and 5843 MHz may be chosen, but the cable modem receive frequency (channel) is determined from the wireless frequency. Note that the downstream CATV frequency may be different than the cable modem receive frequency. This is generally not a concern as most DOCSIS systems on which there is only one DOCSIS downstream channel on the cable network do not specify the CM receive frequency in the CM configuration file, rather they let the CM find the downstream on its own.

Upstream Configuration

The ARCXtend upstream block diagram is illustrated in Figure 3-4. Note that the North American DOCSIS (Version 1.0 and 1.1) QPSK or QAM upstream signal is up to 3.2 MHz wide. DOCSIS 2.0 upstream signals can be as much as 6.4 MHz wide. All frequencies specified in this section are the center frequency of the particular signal.

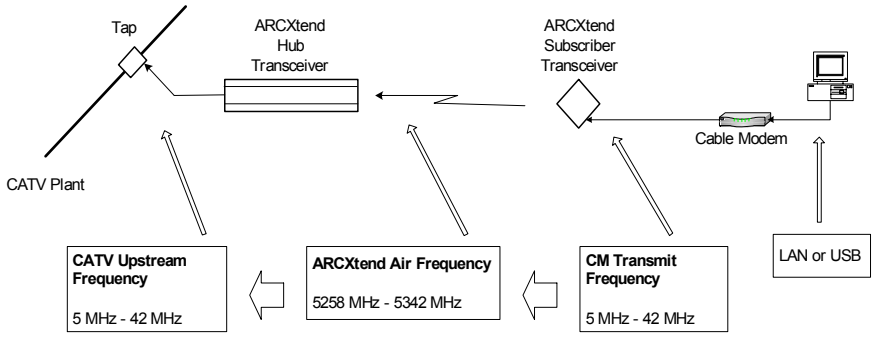


Figure 3-4: ARCXtend Upstream Block Diagram

Upstream Block Diagram

The cable modem (CM) is commanded by the downstream signal to transmit at a specific upstream frequency between 10 MHz and 42 MHz. Any upstream channel frequency between 10 and 42 MHz will work with ARCXtend.

Referring to Figure 3-4 from right to left:

The ARCXtend Subscriber Transceiver (CPE) up converts and transmits the entire cable upstream band.

The Hub receives only the selected wireless upstream channel. The upstream wireless channel is centered at 5,720 MHz plus the upstream DOCSIS channel frequency: e.g. Upstream Channel 29.5 MHz is transmitted at 5,749.5 MHz.

ARCXtend Multiple Hub Configurations

Downstream

If multiple ARCXtend Hubs are to be installed such that more than one Hub is visible (line of sight) from any ARCXtend subscriber transceiver (CPE), additional measures must be taken. A receiver will not operate properly if it "sees" signal on the same frequency from more than one transmitter such that the two or more signals arrive at the receiver at levels within approximately 25 dB of each other. (If the desired signal is greater than approximately 25 dB stronger than the undesired, the receiver will function).

Since the ARCXtend downstream configuration can map the CATV plant downstream channel to any of the specified air frequencies, the solution is to choose different downstream air frequencies for each visible ARCXtend Hub.

Upstream

Similarly, if multiple ARCXtend Hubs are to be installed to cover a larger geographic area than can be accommodated by the antenna pattern of one Hub, but in close enough proximity that more than one Hub can "see" the upstream signal from a particular CPE operating at the same upstream air frequency then there must he at least 25 dB separation for 64 QAM and 30 dB separation for 256 QAM operation between the two CPE's.

If this signal separation can't be achieved then you must use different DOCSIS upstream channels for each Hub. This means that each CM transmit frequency will be passed upstream into the CATV plant.

IP Network Preparation

Hub's Default IP Address

The ARCXtend Network Hub (Hub) utilizes an IP address in the cable network for remote management and automatic of configuration of Hub parameters.

If an IP address is not provided for the Hub, it can be only accessed via the local Ethernet interface and using the default IP address:

- IP address of 192.168.100.1
- Subnet mask 255.255.255.0

Cable Network IP Address

If remote management or plug-n-play installation is desired, the Hub must be assigned an IP address by the cable network. This is accomplished by provisioning the MAC ID of the Hub's embedded cable modem (ECM) MAC ID into the networks OSS/NMS.

DHCP Server Setup

The Hub's ECM requires an IP address and its own unique configuration file. In order for the ECM to be assigned an IP address and be loaded with the proper configuration file the following actions are required:

Set up a DHCP pool on your server for the ARCXtend ECMs to ensure that the ECM is properly configured and addressed.

ECM Configuration File

The ECM has its own DOCSIS standard format configuration file, ecm.cfg, which is pre-loaded at the factory and loaded on the ECM. A copy is also included on the documentation CD and downloadable from the customer support page of the www.arcwave.com web site. The configuration file should be edited prior to installation to confirm the cable network specific settings.

The configuration file for the ARCXtend ECM contains the following information:

- Downstream channel parameters (optional)
- UCD which specifies the upstream channel parameters (optional)
- Authentication parameters (optional)
- Registration parameters (mandatory)
- ECM firmware upgrade file name (optional)

The Hub ECM and attached wireless subscriber cable modem must be assigned to the same upstream frequency and must not be part of an upstream group supporting multiple upstream channels.

TCP/IP Port Filtering

TCP/IP port filtering is the practice of selectively enabling or disabling Transmission Control Protocol (TCP) ports and User Datagram Protocol (UDP) ports on computers or network devices. The following ports must be open for SNMP, HTTP, and TFTP applications to be performed on the Hub:

- Port 161/162 for SNMP
- Port 80 for HTTP
- Port 69 for TFTP

Hub Electrical Interface

The Hub is connected to the cable plant using a power-passing tap spliced in at the desired location on the cable plant.

AC Powering and Surge Protection

In strand mount applications, the Hub is powered through the input RF port. The Hub is capable of 60 Vac or 90 Vac plant power. The internal power supply provides a regulated 24 Vdc output

over an ac input between 50 Vac and 110 Vac with a line frequency from 50 Hz through 60 Hz. A 20-ampere fuse is furnished in the power supply module and provides over current protection for ac power applied to the input. SCTE compliant surge protection is provided in the power supply.

DC Powering

The Hub can also be powered through the weather-protected Ethernet port using Power-over-Ethernet. The power level at the Ethernet Port should be between 18 and 26 Vdc.

RF Signal Power Level and Quality

The Hub requires a downstream path RF power level at the input RF port of between 0 dBmV and +30 dBmV. The modulation error ratio (MER) going at the input RF port should be within the budgeted range for the wireless link. In general a minimum MER of 35 dB is required for 256 QAM and 31 dB is required for 64 QAM downstream path modulations.

CPE Electrical Interface

The CPE is powered over and connects to the cable modem, using standard coaxial cable.

AC Powering and Surge Protection

The CPE is powered through the RF output port. The CPE is powered with 18 Vdc. Arcwave provides a 120 VAC CPE power pack and a power inserter approved for use with the CPE. The CPE must typically be located within 300 feet of the power pack to insure adequate powering of the CPE.

Lightning Protection

The CPE must be mounted at least 2 feet below the highest point at the site to minimize the likelihood of lightning strikes. The location should be properly grounded for lightning protection to all applicable national (National Electric Code, sections 820-33 and 820-40) and local codes.

To protect the customer equipment from surges on the coaxial cable that is connecting the CPE to the cable modem, the installation of an SCTE compliant surge protector is required.

INSTALLATION AND COMMISSIONING

Proper installation and verification are critical elements to achieving optimal wireless performance. This section provides cable plant installation professionals with a step-by-step procedure and troubleshooting guide for successfully deploying Arcwave's ARCXtend Wireless Plant Extension Solution.

Action items are preceded with by the ☞ symbol.

Prerequisites

Professionals using this process should be trained and familiar with installation and troubleshooting of cable drops, cable modems, and with the operation of ARCXtend.

Pre-deployment planning should be completed including the IP network preparation required for initialization of the embedded cable modem.

Link Budget

Wireless link planning and RF link budgeting should be completed prior to attempting an ARCXtend installation. The measured signal level values for the wireless link and cable network interfaces should be recorded during the installation and commissioning process.

Personnel

This guide is designed to be used by cable plant installation professionals. It can be performed by one person with the proper training, wireless link planning, and tools. It is recommended, however, that two people be present during the alignment process between the hub and CPE: one person located at the network hub and the other at the CPE.

Equipment and Materials

Equipment	Source	Use
AR100 Signal Strength Meter	Arcwave	CPE Alignment
Digital Cable TV Installation Meter	Sunrise Telecom Hukk CM500 or equivalent	Hub installation & link commissioning
7/16" & ½" wrench	Multiple	Hub and CPE installation
Spotting Scope or Binoculars	Multiple	Hub site selection
Range Finder	Multiple	Hub site selection
GPS Receiver	Multiple	Hub site selection
Bucket Truck	Multiple	Hub Installation
Walkie Talkies or Cell phones	Multiple	Communicate between Hub and CPE sites
Laptop Computer w/	Multiple	Hub monitoring and configuration

Serial & Ethernet Ports		
Material	Source	Use
ARCXtend Network Hub	Arcwave AX1455-SM-25, -60 or -90 and AX1455-VM-90	Wirless interface to cable network on plant side
ARCXtend CPE	Arcwave AX1455-VM-12	Wirless interface to cable network on customer side
ARCXtend CPE Power Adaptor and DC Inserter	Arcwave AX1455-PS-12	Powering CPE
ARCXtend Network Hub Management Kit, M/N	Arcwave AX1455-IFK-232	Hub Interface Cable Kit
10dB and 20dB low pass attenuators	Arcwave AX1455-ECF-10 AX1455-ECF-20	Attenuate CPE downstream output power level
Power Passing Tap	Multiple	Provides RF signal and power for network hub
CPE Mounting Hardware	Valmont, Patriot Antenna Systems, Wade Antenna Ltd.,	Mounting CPE at the installation site
RG-6 coaxial cable and male “F” type connectors	Multiple	Connecting the network hub to the power passing tap Connecting the CPE to the cable modem
Ground device	Multiple	Grounding the CPE installation
Surge Protector	Array Solutions Model 310	Protects the cable modem and susbcriber equipment from damage due to a lightning strike.

Table 4-1: Installation Equipment & Materials

Equipment Ordering and Staging

Once you have completed the wireless link planning process you are ready to order or pull from inventory the necessary equipment. At this point you should verify you have all the equipment and tools required to complete the installation.

Hub installation & commissioning

Setup the Hub Power and RF Connection

☞ Install a power passing tap at the desired hub location on the cable plant and verify that the AC power level, the downstream RF signal power level, and the downstream modulation error rate (MER) meets ARCXtend requirements as listed below:

1. Verify that the input power is between 50 Vac and 110 Vac nominal.
2. Verify that the input downstream RF signal level is between 0 dBmV and +30 dBmV.
3. Verify that the downstream modulation error ratio (MER) going into the hub is within the budgeted range for this link. In general a minimum MER of approximately 35 dB is required for 256 QAM operation and 31 dB is required for 64 QAM operation.

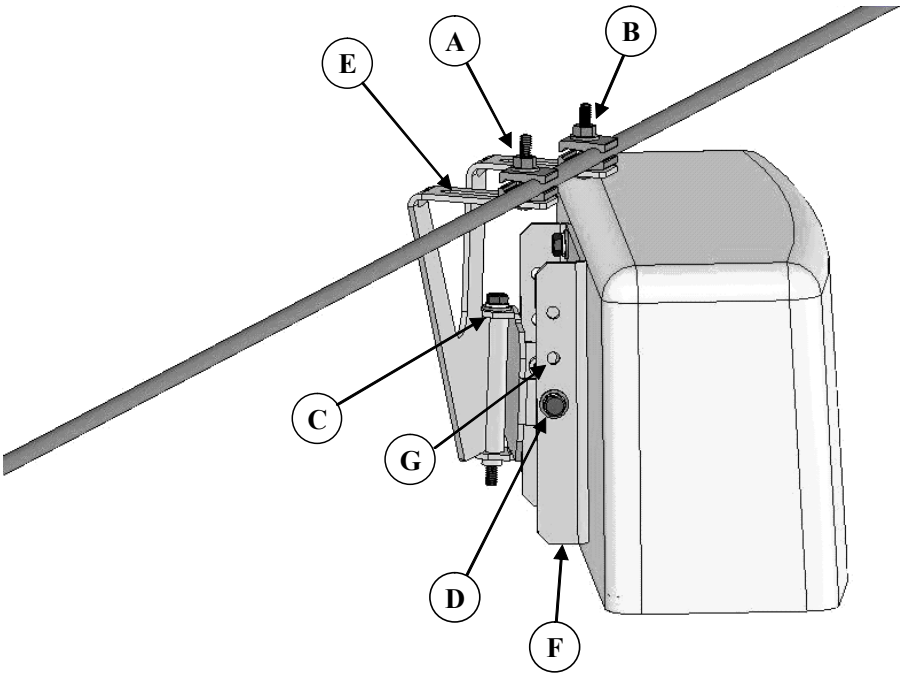


Figure 4-1: Hub Installation Diagram

Secure the Hub to the Strand

☞ Using the antenna pattern decals located on the top and side of the hub, align the hub antenna in the approximate direction of customer site(s). Install as shown in Figure 4-1 per the steps provided below using a 7/16” combination or socket wrench. It is recommended that the hub be located on the strand as close as possible to the utility pole to minimize swaying in windy conditions.

1. Attach the bracket to the messenger strand with the hanger bolts at A and B. Tighten the hanger bolts lightly. If the existing cable bundle lashed below the messenger strand

is sufficiently thick to interfere with the top of the Hub cover, the two elevation adjustment bolts D can be relocated to a pair of upper holes G on the back plate F.

2. Loosen horizontal adjustment bolt C and rotate the hub so that it is pointed at the center of the area to be served by this hub. Tighten azimuth adjustment bolt C.
3. Loosen the two elevation adjustment bolts at D (one on each side of the mounting bracket) and tip the Hub back plate F so that it is parallel to the azimuth adjustment bolt C. Tighten the elevation adjustment bolts lightly.
4. Loosen the hanger bolts A and B and slide them in the slots E at the top of the mounting bracket until the hub balances and the back plate F is perpendicular to the ground. Tighten the hanger bolts A and B.
5. Loosen the two elevation adjustment bolts at D (one on each side of the mounting bracket) and tip the hub up or down to point it at the center of the area to be served. Tighten the two elevation adjustment bolts D.
6. Ensure that all bolts are tightened securely.
7. Using a 75 ohm F connector coaxial cable, connect the Hub to the power passing tap.
8. This completes the physical installation of the Hub.

Establish a Local Connection to the Hub

☞Connect a laptop computer to the RJ-45 Ethernet port of the Hub and connect to the Hub via an Internet Explorer 5.x or higher with the IP address set to 192.168.100.1.

Note: If your lap top Ethernet Port alternates between “connected” and “not connected” you should reconfigure its LAN port speed and duplex setting from Auto to 10Mbps.

The hub should respond with the “Enter Network Password” prompt**.**

Enter the “user id” and password. The default user id “admin” and password is “arcwave”.

Verify the Embedded Cable Modem has achieved operational maintenance state.

☞ Referring to the Cable Status page of the user interface:

Verify that the Embedded Cable Modem has successfully completed its initialization sequence. If it has not, troubleshoot per normal procedures.

Set up and verify the Hub’s cable plant interface

☞ Referring to the Arcwave MIB page of the user interface:

- Verify that the Upstream Frequency and CATV EIA Input Channel settings are correct. If Cable Interface Control and Automatic Frequency Set are enabled these values will be entered automatically based on the values being used by the ECM. You can override these values by disabling the Cable Interface Control and Automatic Frequency Set features and entering them manually,
- Verify that DCE Lock is set to true.

Set up and verify the Hub's wireless interface

☞Referring to the Arcwave MIB page of the user interface:

- Set the **Downstream Air Frequency**.
- Set **Select Downstream Power** level the appropriate setting:
    a. High for use with AX1455-SM-90, AX1455-SM-60, and AX1455-VM-90 Model Hubs operating with 64 QAM downstream modulation and links greater than ¼ mile.
    b. Medium for use with all model Hubs operating with 256 QAM downstream modulation and 64 QAM modulation with links less than or equal to ¼ mile.
    c. Low for use with all model Hubs at links less than 500 feet.

Note: The "High" power setting is for use with the AX1455-SM-90, AX1455-SM-60 and AX1455-VM-90 Network Hubs. Use of the "High" power setting with the AX1455-SM-25 cancels the FCC certification and voids the user's authority to operate the unit in the 5.8 GHz band.

- Verify that **Downstream Enable** and **Upstream Enable** are set to **true**.

If the Cable Interface Control is enabled and the ECM is operational, the **Upstream Attenuation** level is set automatically based on the upstream transmit power level of the ECM. If the ECM is not operation, then the Upstream Attenuation level must be set manually. A good starting point is 30 dB.

- Verify that **Downstream Lock** and **Upstream Lock** are set to true.

Set the Hub Management Mode

☞Referring to the Administration table on the Maintenance page and Arcwave MIB page of the user interface:

1. Enter Title, if desired, otherwise it defaults to the MAC address of the ECM.
2. Choose the method for managing the Hub by setting the **Select Control Mode**:
    - If Control via HTTP is chosen, then the Hub can be managed remotely over the cable network or locally using the Ethernet port and the HTTP-based user interface.
    - If the Control via SNMP is chosen, then the Hub can be managed remotely over the cable network using SNMP.
3. Set the Alarm Destination IP address, id desired.

CPE installation

☞Install the mounting hardawre (e.g. non-penetrating roof mount, eaves mount) and wiring per the manufacturer's recommended procedures and in accordance with the National Electric Code and local ordinances.

Note: The CPE accommodates a mounting pipe with of 1-1/4" to 2-3/8" in diameter and the CPE and mounting pipe require a minimum of 12 inches clearance on all sides for optimal performance.

Note: The CPE should be located as close to the edge of the building nearest the hub as possible. When the CPE is mounted towards the middle or back of the building, the incoming wireless signal may be reflected by the rooftop impairing the performance of the link. The CPE must be placed high enough on the rooftop to provide the required Fresnel zone clearance (Fresnel zone = blockage free zone).

Affix the CPE mounting mast

☞ Referring to Figure 4-2, loosen the "Side/side alignment bolts and slide the CPE over the mounting pipe. Visually align the CPE in the direction of the Hub and snug the side/side alignment bolts to hold the CPE in place.

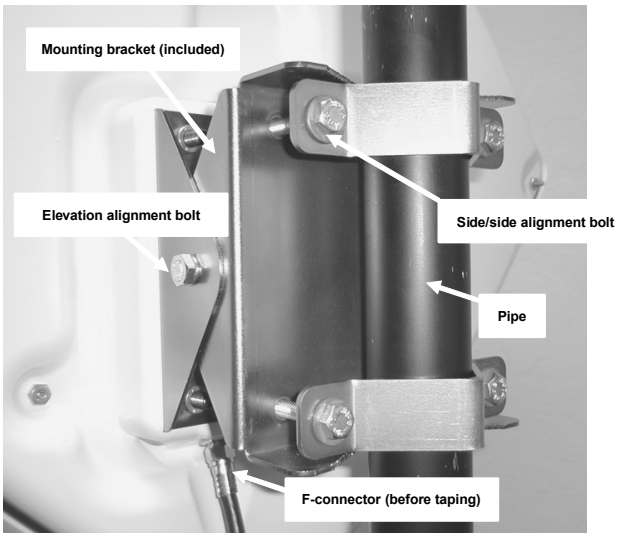


Figure 4-2: CPE Mounting Diagram

Install the Coaxial Cable and Ground Connection

☞ Install the coaxial cable and ground connection as shown in Figure 4-3:

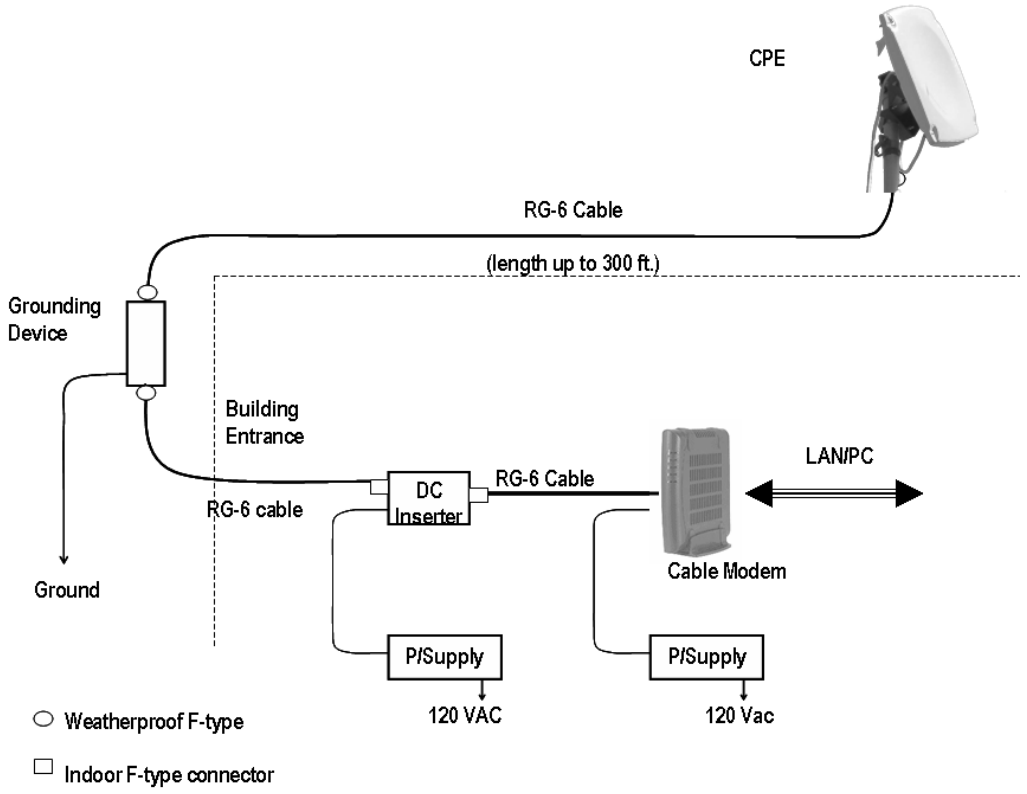


Figure 4-3: CPE Wiring Diagram

☞ Connect an RG-6 coaxial cable to the F connector located on the rear of the CPE. Waterproof the connection using a suitable method such as taping with Coax-Seal[2] or Scotch #88.

Note: Be sure to leave sufficient cable slack for final CPE alignment and ensure that the cable runs directly downward from the connector to avoid water running down the cable and into the F connection.

☞ Route the coaxial cable to the building entry point utilizing UV-resistant tie-wraps and staples or cable clamps as required.

Note: UV-rated cable should be used outdoors. In some buildings plenum-rated or riser-rated cable is required for inside runs.

[2] Coax-Seal is available from Universal Electronics, Inc. Phone: 828-293-2222.

☞ Mount a CATV system standard grounding device in Figure 4-4 as close as possible to the point of cable entry into the building. Connect the grounding device to a suitable "grounding electrode" as required per local building codes.[3]

☞ Connect the RG-6 coaxial cable from the CPE to the grounding device and waterproof all outdoor F connectors.

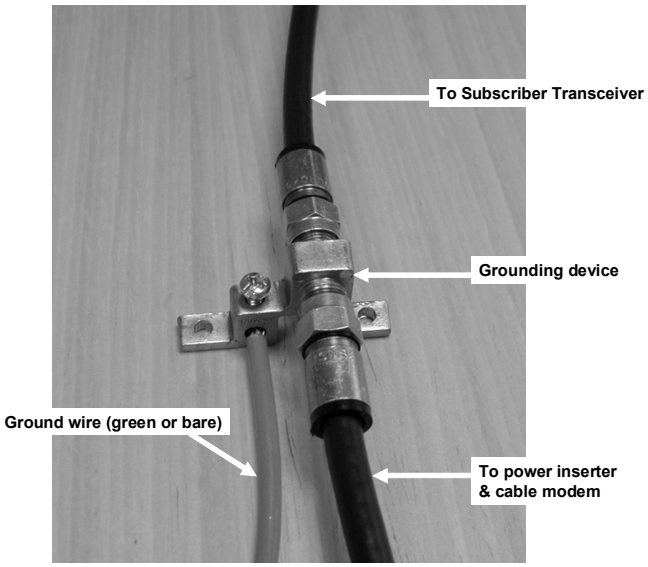


Figure 4-4: Grounding device at subscriber premises

☞ Inside the subscriber premises, route the RG-6 from the building entrance point to where the cable modem will be used.

☞ Terminate and install an F connector on the cable. Connect the cable from the CPE to the "RF + PWR" F female connector of the power inserter.

Install the power adaptor and DC inserter

☞ Install the DC inserter as show in Figure 4-5. Connect the power adaptor to the DC inserter as show in Figure 4-3 and figure 4-5. Plug the power adaptor into a surge protected AC power receptacle. Note the AC Power Pack must be within 300 feet of the CPE.

[3] The National Electric Code, sections 820-33 and 820-40, describes this requirement in detail.

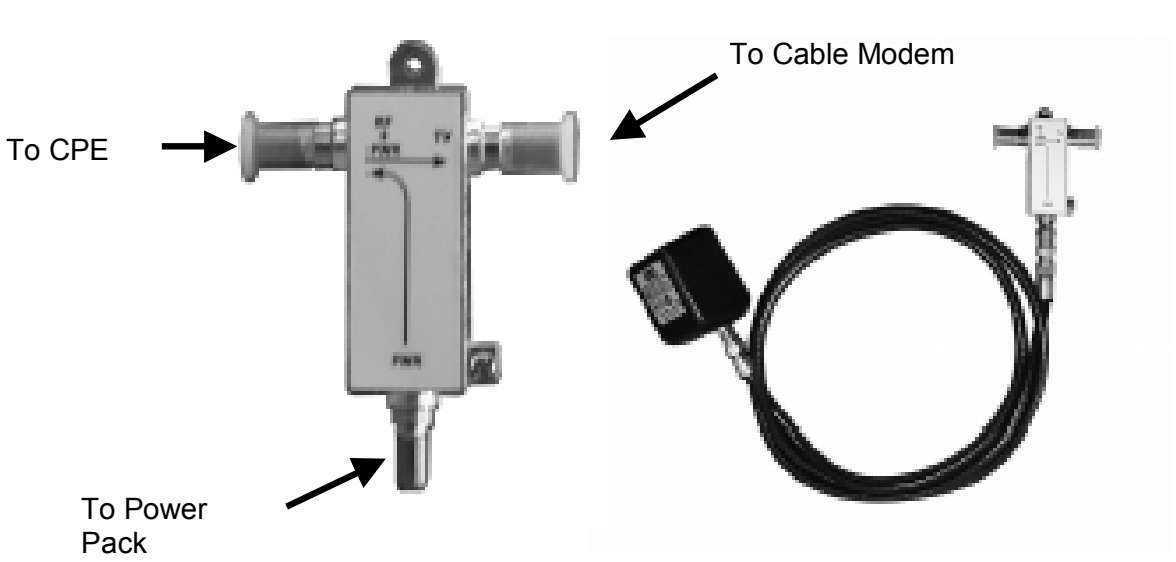


Figure 4-5: Power Inserter and AC/DC adaptor

CPE Alignment

Note: The higher the received signal level, the less likely the system will be affected by interference, plant variations, and geography. High received signal strengths are obtained by proper alignment of the CPE to the Hub.

Connect the signal strength meter

☞Connect the port of the DC inserter going to the cable modem to the RX side of the AR100 signal strength meter (depicted in Figure 4-6) or equivalent signal strength meter .

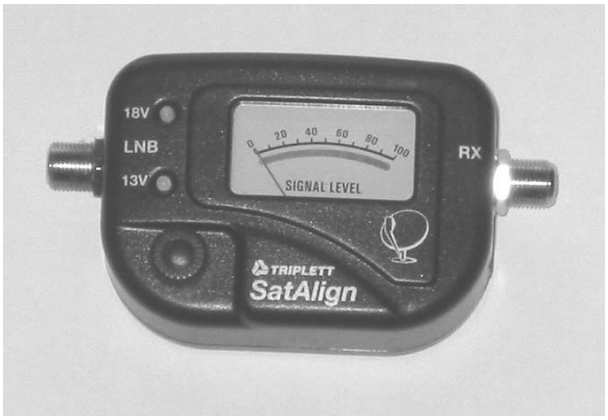


Figure 4-6: AR100 Signal Strength Meter (SSM)

☞Align the CPE for maximum signal strength as follows:

1. Using a 7/16” wrench (open end, box or socket), loosen the two elevation alignment bolts until the CPE can be tilted up or down by hand, but will hold its position.
2. Observe the display of the alignment device being employed and orient the CPE up and down to achieve a maximum peak signal. Adjust the gain control on the AR100 as needed.
3. Tighten the elevation alignment bolts slightly.
4. Using the same wrench loosen the four mounting bolts so the CPE can be oriented side to side by hand.
5. Observe the display of the alignment device being employed and orient the CPE side to side to achieve a maximum peak signal.
6. Tighten the elevation alignment bolts slightly.
7. Repeat the elevation (tilt up or down) adjustment, and then the azimuth (side by side) adjustment once again.
8. Tighten the elevation alignment (tilt) bolts, taking care not to over tighten.
9. Tighten the mounting bolts firmly, but do not over tighten.
10. Disconnect the coaxial cable from the RX side of the AR100 and connect to the cable modem.

Verify CPE output signal at input to cable modem

☞ Using a Digital Cable TV Installation Meter, measure the downstream RF channel power level. The typical target power level range is between 0 and +7 dBmV.

DS received power level is too high	DS received power level is too low	DS signal is not present
If the DS received power level is too high install one or more 10 dB (AX3255-ECF-10) or 20 dB (AX3255-ECF-20) low pass attenuators between the power inserter and the cable modem. If more than 30 dB of attenuation is required and the **Select Downstream Power** setting is **High,** change the setting to **Medium.**	Verify Downstream Power setting is correct. Reduce the cable and RF hardware loss between CPE and cable modem or add bi-directional amplification. Redo the CPE alignment process Verify the wireless range and LOS path between Hub and CPE are within specified limits.	Verify integrity of in-building cabling and power. Make sure CPE Power Adaptor and DC inserter are installed properly. Check DC power level at input to CPE. Check coaxial cable connections. Verify the wireless range and LOS path between Hub and CPE are within specified limits.

Table 4-2: DS power level at CPE

Cable Modem Installation

☞Connect the cable modem to the modem side of the DC power inserter as shown in Figure 4-4 and Figure 4-6. Complete installation of the cable modem using normal procedures.

If the cable modem registers with the network

Verify the downstream signal level

☞ Using the cable modem's diagnostic interface, check that the downstream signal level is within the desired cable modem operating range.

DS received power level is too high	DS received power level is too low
If the DS received power level is too high install one or more 10 dB (AX3255-ECF-10) or 20 dB (AX3255-ECF-20) low pass attenuators between the power inserter and the cable modem. If more than 30 dB of attenuation is required and the Select Downstream Power setting is High, change the setting to Medium.	Check that the Select Downstream Power setting is correct. Reduce the cable and RF hardware loss between CPE and cable modem or add bi-directional amplification. Redo the CPE alignment process Verify the wireless range and LOS path between Hub and CPE are within specified limits.

Table 4-3: DS received power level at the Cable Modem

Verify the upstream signal level

☞Using the cable modem's diagnostic interface, check the upstream signal (US) level is within the desired operating range.

US transmit power of the cable modem is too high	US transmit power of the cable modem is too low
If the US transmit power is too high, decrease the Upstream Attenuation in the Arcwave MIB Maintenance page of the user interface setting by an amount equal to the desired decrease in the upstream power level. i.e. if the US transmit power is 50 dBmv and it should be 45 dBmV then reduced the Upstream Attenuation setting by 50 dBmV minus 45 dBmV, or 5 dBmV. Reduce the cable and RF hardware loss	If the US transmit power is too low, increase the Upstream Attenuation in the Arcwave MIB Maintenance page of the user interface setting by an amount equal to the desired increase in the upstream power level. i.e. if the US transmit power is 40 dBmv and it should be 45 dBmV then increase the Upstream Attenuation setting by 50 dBmV minus 45 dBmV, or 5 dBmV.

between CPE and cable modem or add amplification. Redo the CPE alignment process Verify the wireless range and LOS path between Hub and CPE are within specified limits.	

Table 4-4: US transmit power level troubleshooting

If the cable modem doesn't register with the network

If the cable modem does not register with the network, troubleshoot as follows:

Problem	Solution
Does not detect and lock on DS channel	Check to see if the MER of the downstream RF channel is within specificied limits: MER should be at or above 27 dB for 64 QAM, and 31 dB for 256 QAM. If it is not, check the following: Verify that the Select Downstream Power setting is correct for the downstream modulation and wireless range. Change Downstream Air Frequency to a different channel to rule out interference. Verify the wireless range and LOS path between Hub and CPE are within specified limits.
Does not detect and lock on US channel	Using the cable modem's diagnostic interface, see if the cable modem is seeing the correct upstream RF channel. If it does see the channel and can't lock on, reduce the Upstream Attenuation setting at the Hub. If it does not see the channel, and Cable Interface Control and Automatic Frequency Set are enabled, verify that the Hub ECM and the subscriber cable modem are assigned to the same upstream frequency and are excluded from an upstream load balancing group.

	If it does not see the channel, go to the Hub and check the following: Using -20 dB monitor port of the Hub verify the Hub is receiving a wireless signal from the CPE. If there is a signal, vary the Upstream Attenuation setting at Hub until the cable modem locks on the US channel. If there is not a signal: Verify that the cable modem transmitter is working. Replace the CPE
Cable Modem does not receive an IP address	Perform normal cable modem installation troubleshooting procedures.
Cable modem does not receive time of day (ToD)	Perform normal cable modem installation troubleshooting
Cable modem does not receive config file	Perform normal cable modem installation troubleshooting
Cable modem initializes, receives a config file, and then reboots	Make sure the configuration file being downloaded to the cable modem does not contain downstream channel information. The downstream RF channel frequency being delivered by the CPE to the Cable Modem is different than what is received at the Hub.

Table 4-5: Cable modem registration

Link Verification

Downstream path measurements

DS Modulation	Expected Performance	Troubleshooting
64 QAM	27 dB MER 10^{-8} BER, post-error correction	Inspect the constellation to determine the type of impairment affecting the signal and troubleshoot accordingly. Verify the plant MER is greater than required for the downstream modulation
256QAM	31 dB MER 10^{-8} BER, post-error correction	Verify the downstream power level into the cable modem is between -6 dBmv and +15 dBmV. Inspect the constellation to determine the type of impairment affecting the signal and troubleshoot accordingly. Verify the plant MER is greater than required for the downstream modulation

Table 4-6: Downstream path measurements

Upstream path measurements

Parameter	Expected Performance	Troubleshooting
CM output Power	+40-52 dBmV typical. 58 dBmV max for QPSK, 55 dBmV for 16 QAM	If CM output power is too high, reduce the amount of loss in the drop to allow for margin or reduce the Upstream Attenuation setting.
BER	10^{-8} BER, post-error correction for QPSK and 16 QAM To test BER on the return path, the analyzer can ping the CMTS with a packet of known data. The ping command will return the packet to the analyzer from the CMTS on the downstream path. To be sure the packet does not go any further than the CMTS port; the analyzer can use a trace route command to the	Verify RF return path performance with the wireless link. Check for interference in the 5.250 to 5.350 GHz band. If interference is present, try changing the upstream frequency HI/LO setting.

	dynamic host configuration protocol (DHCP) server to determine the route. The first Internet protocol (IP) address in the route to server is the CMTS port.	

Table 4-7: Upstream Path Measurements

USER INTERFACE

The Hub contains an HTTP-based web tool that can be used to interface to the unit. Following is a guide to using this tool. The following functions are supported: System Info, Cable Status, Signal, Event Log, Maintenance, and Arcwave MIB.

Accessing the Interface

To access the interface you first must be logged onto a computer that is in some way connected to the Hub. This can be done either directly using the RJ-45 port on the Hub or through the cable network. Enter the IP address of the Hub (default IP address on the Ethernet interface is 192.168.100.1) into the address bar of your browser and press the enter key on your keyboard.

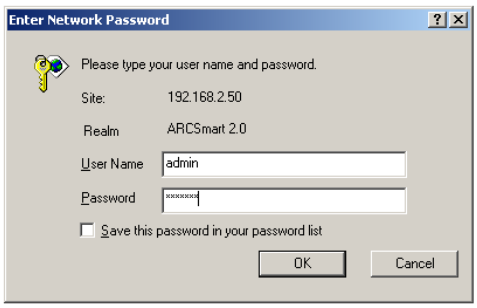


Figure 5-1: Hub login screen

When the Hub is accessed the user is presented with a login screen (Figure 5-1). The user id is ‘admin” and the password is ‘arcwave” (all lower case without quotes). The user id and password can be changed using the Maintenance page.

Cable Status Page

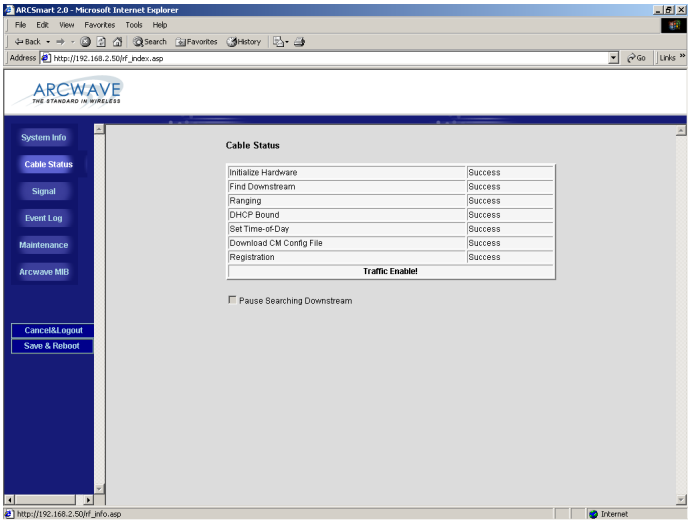


Figure 5-2: Cable Status page

The Cable Status page is the default web page and contains information on the status of the ECM. Figure 5-2 shows the results for a normal ECM connection to the cable network. If the ECM has failed to connect properly to the cable network, fewer of the tasks will be registered as Success. The first one not showing as Success will be the task that is failing.

Initialize Hardware	The embedded modem check its hardware
Find Downstream	The embedded modem find the available downstream frequency
Ranging	After the embedded modem locks onto the available downstream. It will get the upstream information from CMTS and try to find the available upstream channel. It will adjust the upstream tranmist power such that the CMTS receives the signal at the desired power level.
DHCP Bound	The embedded modem is getting IP address from DHCP server
Set Time-of-Day	The embedded modem is trying to synchronize the device time with TOD (time of day) server. The modem still can get registered even it fails in getting TOD response.
Download CM Config file	The embedded modem is getting configuration file from TFTP server. And the IP address of TFTP server should be specified in DHCP options
Registration	The embedded modem use the configuration parameters inside Cable Modem config file and request service from CMTS
Pause Searching Downstream	Stop all the tasks from downstream searching. Thus the embedded modem will not try to register with CMTS

System Info Page

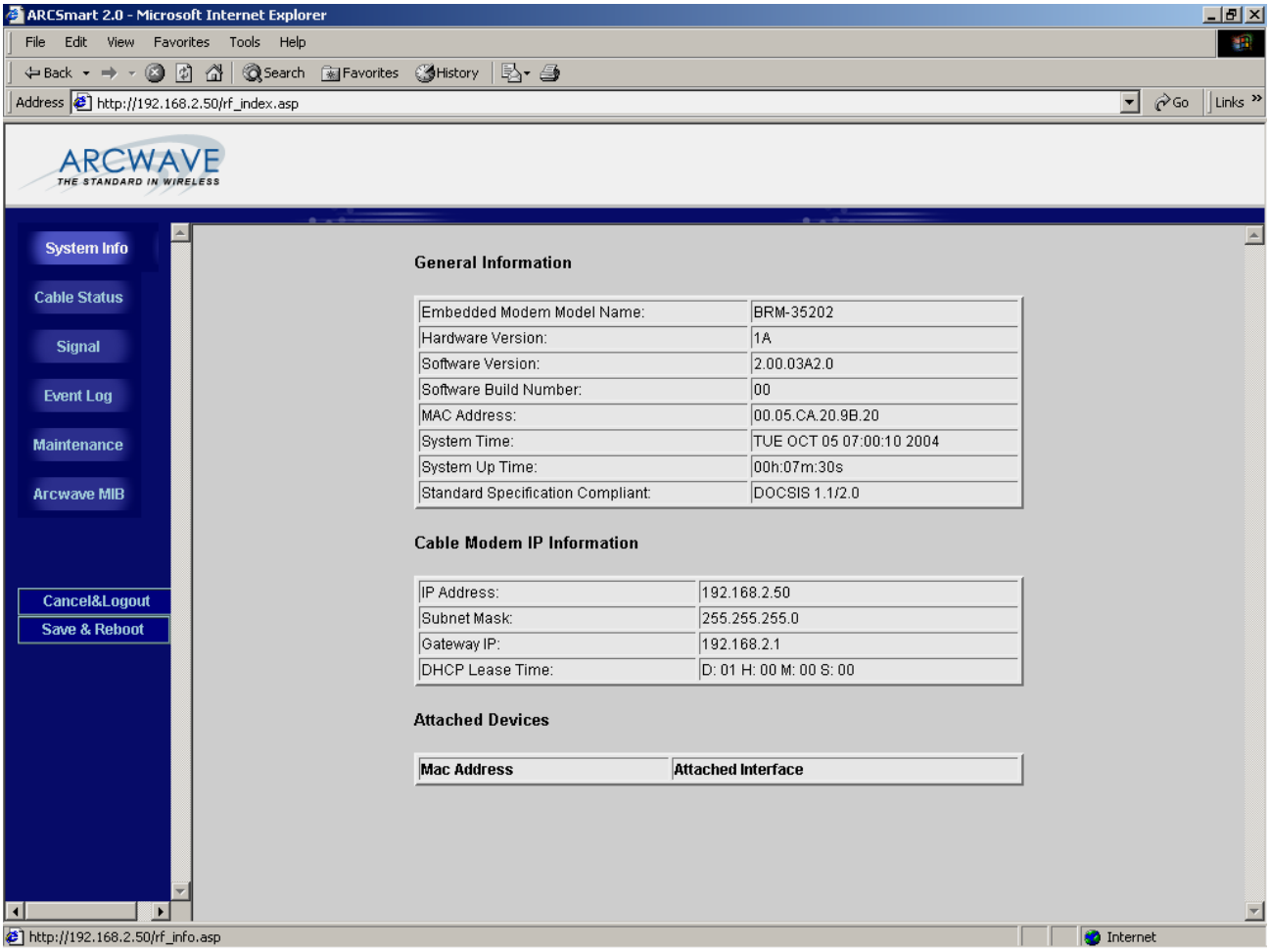


Figure 5-3: System Info page

The System info page contains General Information on the ECM including hardware and software revision, MAC address, and DOCSIS standard compliance. It also contains Cable Modem IP information that provides important IP networking information required to access the ECM.

General Information

Embedded Modem Model Name	The model name of the Modem that embedded inside *<ARCXtend 1255>*
Hardware Version	The hardware version of the embedded modem
Software Version	The software version of the embedded modem
Software Build Number	The minor software version of the embedded modem. Some times if the same code were compiled in different time, it will has different build number. Generally it will be “00”.
MAC Address	The MAC address of the embedded modem. This is used to provision the device to be access. This MAC address should be added in the DHCP server behind CMTS

	Ethernet side. And need to assign the MAC address with corresponding configuration to get service.
System Time	The time that embedded modem get from TOD server and the time-offset configure on DHCP server.
System Up Tome	The duration from the last system boot up
Standard Specification Compliant	The standard specification that embedded modem complies with. DOCSIS 1.1/DOCSIS 2.0 stands for that this is a DOCSIS 2.0 Modem and backward compatible with DOCSIS 1.1. If it shows DOCSIS 1.1 only that means this is a DOCSIS 1.1 only cable modem.

Cable Modem IP Information

IP Address	The IP address that embedded modem get from the DHCP server
Subnet Mask	The subnet mask of embedded modem that assigned from DHCP server
Gateway IP	The default gateway IP address of embedded modem that assigned from DHCP server
DHCP Lease Time	The lease time that embedded modem get from the DHCP server

Attached Device

MAC Address	The MAC address of other device that attached with this embedded modem.

Signal Page

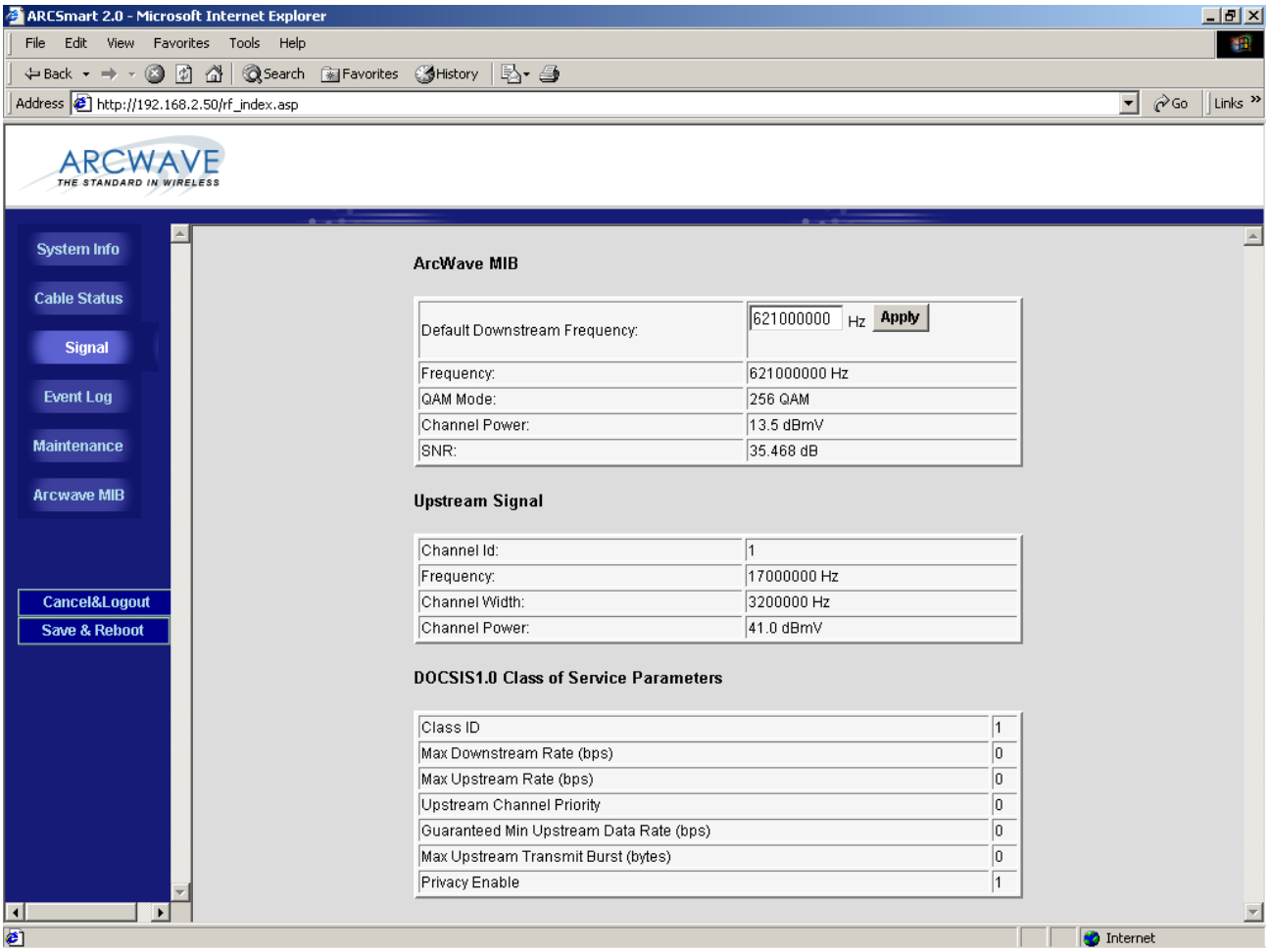


Figure 5-4: Signal Page

The Signal Page contains information on the signal status of the upstream and downstream DOCSIS channels:

Arcwave MIB

Default Downstream Frequency	Optionally choose the frequency where the ECM should first attempt to acquire the downstream RF channel. This setting will speed up the downstream RF channel acquisition time by instructing the ECM to go directly to the indicated frequency where the RF channel is located.
Frequency	The frequency of the downstream channel that ECM is locked on.
QAM Mode	The modulation of the downstream channel that ECM is locked on.
Channel Power	The power level that ECM receives at this location.
SNR	The signal noise ratio that the ECM receives at this location.

Upstream Signal

Channel ID	The ID of the upstream channel that ECM is either attempting to, or is, locked on.
Frequency	The frequency of that US channel ID
Channel Width	The channel width specified for this US channel ID. (Specified in upstream channel profile inside CMTS)
Channel Power	The transmit power of the ECM. The Channel Power displayed is 10 dB higher than the actual upstream power level at the F connector on the Hub.

DOCSIS 1.0 Class of Service Parameters

Class ID	Indicates the class of service ID.
Max Downstream Rate (bps)	The maximum downstream data rate that the ECM is permitted to use.
Max Upstream Rate (bps)	The maximum upstream data rate that the ECM is permitted to use.
Upstream Channel Priority	The preferred upstream channel ID for the ECM to use.
Guaranteed Min Upstream Data (bps)	The minimum upstream data rate that is reserved for the ECM to use.
Privacy Enable	Enables the encryption of the frames transmitted using RF signal over coaxial cable between CMTS and the ECM.

Event Log Page

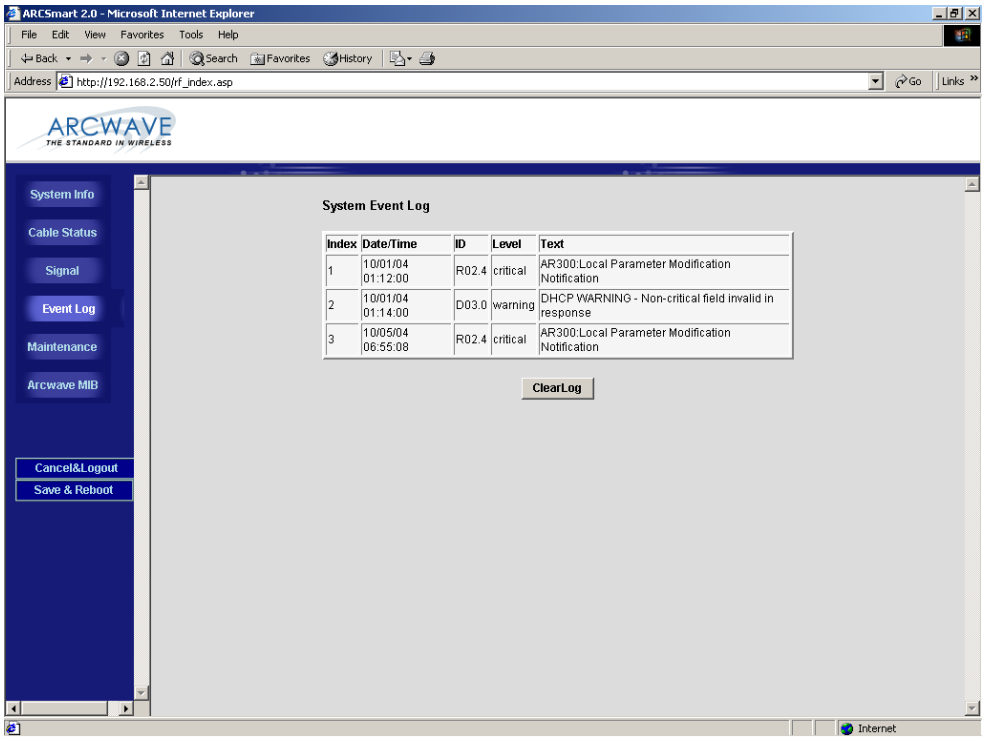


Figure 5-5: System Event Log page

The Event Log page contains event information for the ECM and ARCSmart. The Event Log is presented in reverse chronological order, so the most recent log entry is at the top. Each entry in the log is time stamped in the format MMDDYYhhmmss in GMT (Greenwich Mean Time). The time stamp is replaced by asterisks if the cable modem has not yet acquired the time.

The event log is useful when diagnosing sporadic problems, and can reveal the reason for the ECM having previously gone offline. Not every line in the log represents an error, even if it is flagged as an error. Log entries of events affecting the data service are flagged Critical, Alert, or Emergency. DOCSIS standard events are reported for the ECM and following are the valid ARCSmart 2.0 events:

System Event Log

Index	The sequence in index of according to the time that event occurred.
Date/Time	The date and time that the event occurred
ID	The abbreviation and classification of the event inside the device. Where; T01 is equivalent to T1 timeout - Wait for UCD timeout T02 is equivalent to T2 timeout - Wait for broadcast ranging timeout T03 is equivalent to T3 failure or timeout - Wait for ranging response T04 is equivalent to T4 failure or timeout - Wait for unicast ranging opportunity. T06 is equivalent to T6 failure - Wait for REG-RSP and REG-ACK That defined in CM-SP-RFIv2.0-I06-040804
Level	The severity level of this event
Text	The description of that event
Clear Log	Clear log clears the System Event Log

.

Event Syntax	Event Message Text	Severity	Customer Symptom	Explanation of event /Corrective Action	What will the Customer Experience
AR300 System Lock Lost	The Unit has lost lock in the Upstream or Downstream	Critical	Modems on the ARCXtend system lose sync	The transmitter or receiver module (or both) has lost lock/ Clear alarms and/or reset power on unit & check if condition goes away	Lost of traffic, system outage
AR300 Hub Dead	The Unit is dead.	Critical	Modems on the ARCXtend system lose sync	The transmitter or receiver module or both stop communicating with the control module/ Clear alarms and/or reset power on unit & check if condition goes away	Lost of traffic, system outage
AR300 Input voltage outside of tolerance	Voltage level is either below or above tolerance limits	Major	This alarm gets displayed	The voltage being supplied to the Unit is improper/ Check voltage levels & clear alarm	No immediate impact but could result in loss of traffic, system outage.
Warning: The Hub is operating within 10C of its maximum operating temperature.	The Unit is operating near its maximum operating temperature	Major	This alarm gets displayed	The Unit is operating near its maximum operating temperature. Check temperature and clear alarm. If problem persists consider adding a sun shield to unit.	No immediate impact but could result in loss of traffic, system outage.
AR300 DCE Unlocked or Error	The Control module has lost lock	Critical	Modems on the ARCXtend system lose sync	The Control module has lost lock/ Clear alarms and/or reset power on unit & check if condition goes away	Lost of traffic, system outage
AR300 Upstream (Receiver) Unlocked or Error"	The Upstream module has lost lock.	Critical	Modems on the ARCXtend system lose sync	The Upstream module has lost lock/ Clear alarms and/or reset power on unit & check if condition goes away	Lost of traffic, system outage
AR300 Downstream(Transmitter) Unlocked or Error	The Downstream module has lost lock.	Critical	Modems on the ARCXtend system lose sync	The Downstream module has lost lock/ Clear alarms and/or reset power on unit & check if condition goes away	Lost of traffic, system outage
Local Parameter Modification Notification	There has been a change in the parameters on the control module	Normal	A change in parameters is made via CLI or by the control module	There has been a change in the parameters on the control module/ Do nothing - it's an informative alarm	No impact, informational only. Note changes made via CLI may be reset upon reboot of unit.

Table 5-1: ARCSmart Event Messages

Maintenance

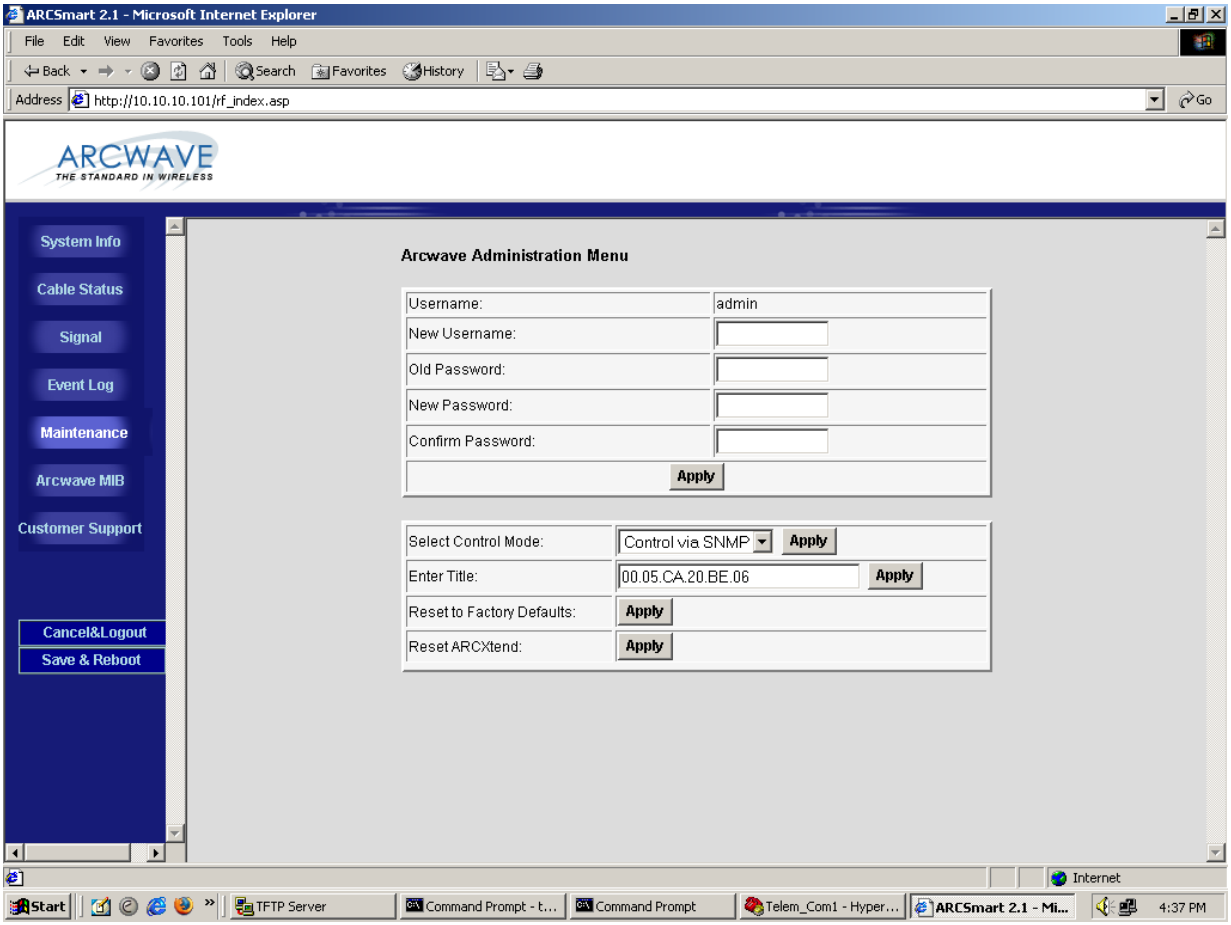


Figure 5-6: Maintenance Page

The Maintenance page provides the ability to change the user id and password. After entering the new username, password and click on the Apply button. The username and password will updated to the new settings.

Arcwave MIB Maintenance

New User Name	New User Name
Old Password	Old User Password.
New Password	New User Password.
Confirm Password	Re-enter New User Password.
Select Control Mode	Chose the method for managing the Hub.
	If Control via HTTP is chosen, then the Hub can be managed remotely over the cable network or locally via the Hub's Ethernet port, using a PC and the HTTP-based user

interface.

If the Control via SNMP is chosen, then the Hub can be managed remotely over the cable network using SNMP.

Enter Title — Enter a 40 characters alphanumeric string. The default setting is the MAC address of the ECM. This parameter can be used to give a unique identifier for the Hub.

Reset to Factory Defaults — Select Apply to return the AR300 MIB settings to the factory default values listed below.

Element	Default Value
Username	admin
Password	arcwave
Control Mode	SNMP
Title	<MAC address of BRM-3520>
Cable Interface Control	Enable
Automatic Frequency Set	Enable
Local Ethernet Interface Control	Enable
Network Access	Disable
Select Upstream Band	High
Upstream Attenuation	99
Downstream Enable	False
Upstream Enable	False
Select Downstream Power	Low
Alarm Mask	FFFF
PureBurst	ON
TFTP Server IP Address	0.0.0.0
Firmware Upgrade Filename	<blank>

Reset ARCXtend — Select Apply to reset the AR300 program counter to one.

Arcwave MIB page

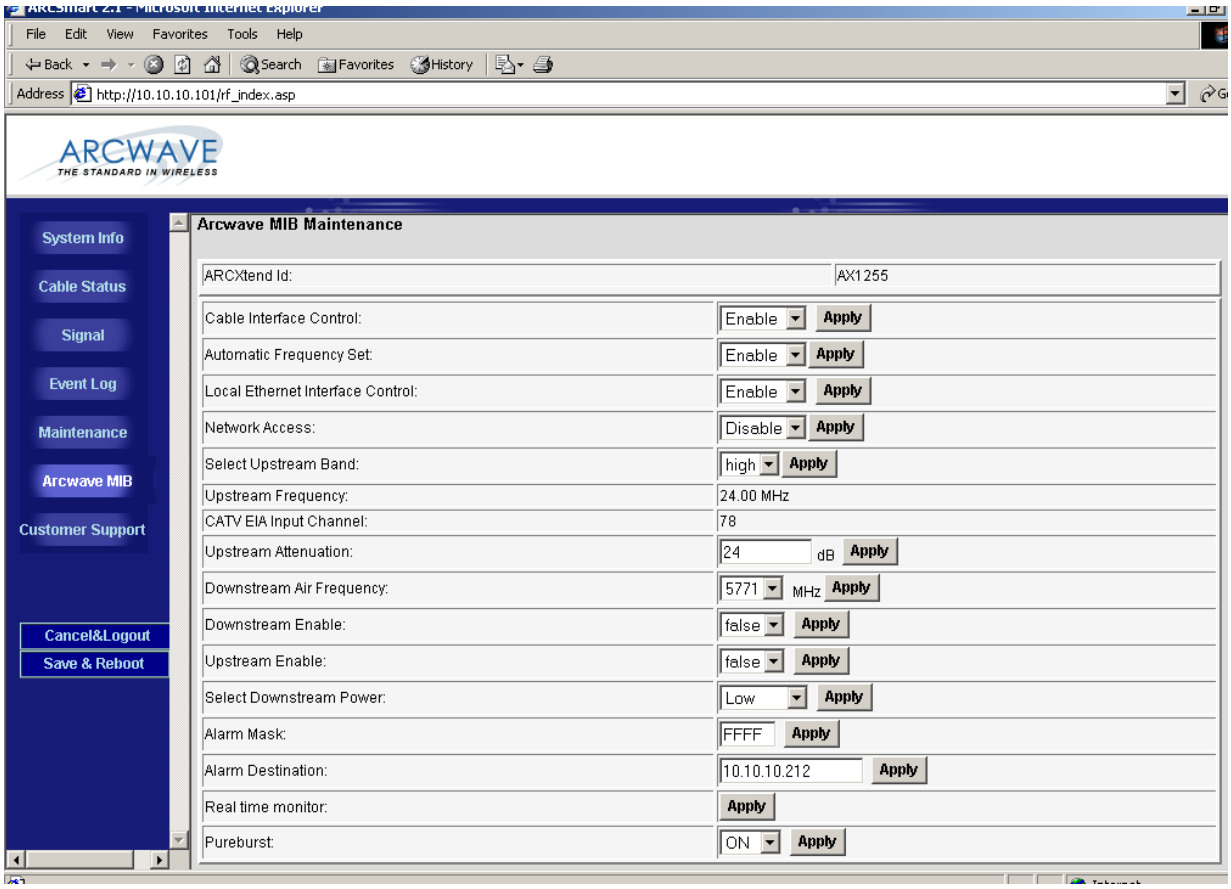


Figure 5-7: Arcwave MIB page - Top

The Arcwave MIB page contains information and configurable parameters pertaining to the operation of the Hub and contained in the Arcwave Enterprise MIB.

Arcwave MIB Maintenance

ARCXtend Id — Displays the Hub type, AX1455, AX1455 Standard Band (5.8 GHz), AX1455 Extended Band (5.8 GHz), AX1555 (future), AX1655 (Enhanced) and AX1755 (future). This parameter is used internally by ARCSmart to customize the user interface based on the Hub type.

Cable Interface Control — Chose “Enable” to turn-on the RF interface of the ECM and “Disable” to turn it off. This parameter is useful when the Hub is used for a non-DOCSIS application, such as the wireless transport of a digital video or CBR (constant bit rate) voice signal, and there is no DOCSIS channel on the cable plant.

Selecting the “Disable” setting will prevent the ECM from continually scanning for a downstream channel, when none is present. The default setting is “Enable”

	When Cable Interface Control is set to “Disable”, Network Access is set to “Disable” and Upstream Attenuation can not be set to “99”, automatic mode.
Auto Frequency Set	Chose “ENABLE” to have ARCSmart automatically program the Hub **CATV EIA Input Channel** and **Upstream Frequency** parameters with the same values used by the ECM. When set to “ENABLE” these parameters will change whenever the values are changed at the ECM. This setting is used for plug-n-play installation of the Hub. Chose “Disable” when these parameters will be set manually to values different than those used by the ECM. In this mode, the values entered will persist regardless of the values used by the ECM and across a Hub power outage or reboot. This mode is useful when the Hub will transmit a non-DOCSIS channel, such as digital video or CBR voice. The default setting is “Enable”. Note: “Cable Interface Control” must be set to “Enable” in order for this element to be set to “Enable”.
Local Ethernet Interface	Chose “Enable” to allow local connection to the Hub via the RJ-45 connector. Chose “Disable” to disable the RJ-45 connection and prevent anyone from connecting locally to the Hub. When Local Ethernet Interface is set to “Disable”, Network Access is also set to “Disable”.
Network Access	Chose “Enable” to allow a locally connecting computer to obtain an IP address, via DHCP, from the head end server and to access the cable IP network. Chose “Disable” to prevent a locally connected computer from accessing the cable IP network. The locally connected computer will be assigned a default IP address in the 192.168.100.0/24 network.
Select Upstream Band	Not used with AX1455.
Upstream Frequency	Displays the frequency of the upstream channel that is being received by the Hub.
CATV EIA Input Channel	Displays the EIA standard channel number of the downstream channel that is being received by the Hub.
Upstream Attenuation	Chose the amount of attenuation (in dB) in the upstream receive path of the Hub. If “99” is entered, ARCSmart will automatically set the attenuation based on the upstream channel transmit power out of the ECM. If a number in the valid range from 0 to 64 is entered, the attenuation is set to that value. This parameter is used to increase or decrease the upstream

	channel transmit power of a cable modem connected wirelessly to a Hub. Increasing the attenuation will cause the CMTS to increase the cable modem's upstream channel transmit power. Decreasing the attenuation will cause the CMTS to decrease the cable modem's upstream channel transmit power. The change in the attenuation and the change in the upstream channel transmit power, while loosely related, is not one to one. Note: "Cable Interface Control" must be set to "Enable" in order for this element to be set to "99" (Automatic Upstream Attenuation setting).
Downstream Air Frequency	Chose the downstream wireless carrier frequency. Valid settings for AX1455 model Hubs are: 5,813, 5,819, 5,825, 5,831, 5,837 and 5,843 (in MHz).
Downstream Enable	Chose "TRUE" to turn on the downstream wireless transmitter and "False" to turn it off. The default setting is "False".
Upstream Enable	Chose "TRUE" to turn on the upstream wireless receiver and "FALSE" to turn it off. The default setting is "False".
Select Downstream Power	Chose the downstream wireless transmitter power setting: High, Medium or Test
Alarm Mask	The alarm mask corresponds to the hex number, which when translated into a binary number gives an 8 digit number. The position of a digit '1', in that number, would enable the corresponding alarm and a digit '0' would disable the corresponding alarm. All 0's masks all alarms, all F's lets all alarms through, individual alarms are respresented as follows: Bit 0: 1 = System Lock Lost Bit 1: 1 = Hub Dead Bit 2: 1 = Input voltage outside of tolerance Bit 3: 1 = Downstream (Transmitter) Over Temperature Bit 4: 1 = DCE Unlocked or Error Bit 5: 1 = Upstream (Receiver) Unlocked or Error Bit 6: 1 = Downstream (Transmitter) Unlocked or Error Bit 7: 1 = Local modification notification Example: If the user wanted alarms "System Lock Lost, Input voltage outside of tolerance, DCE Unlocked or Error and Local Parameter Modification Notification" turned on & the rest turned off, he would have to set the alarm mask to 0095 (Hex), which corresponds to 10010101 (Binary). The bits that correspond to the alarms we want turned on have been set to 1 & the rest have been set to 0.
Alarm Destination	Enter the IP address where SNMP traps are to be sent by the Hub.
Real time monitor	Click on the "Apply" button to refresh the Real Time Monitor

	display.
PureBurst	Chose “On” to enable PureBurst and “Off” to disable PureBurst. When no traffic is present on the upstream cable interface, PureBurst mutes the interface preventing the introduction of ingress noise into the cable network. Default setting is “On”.

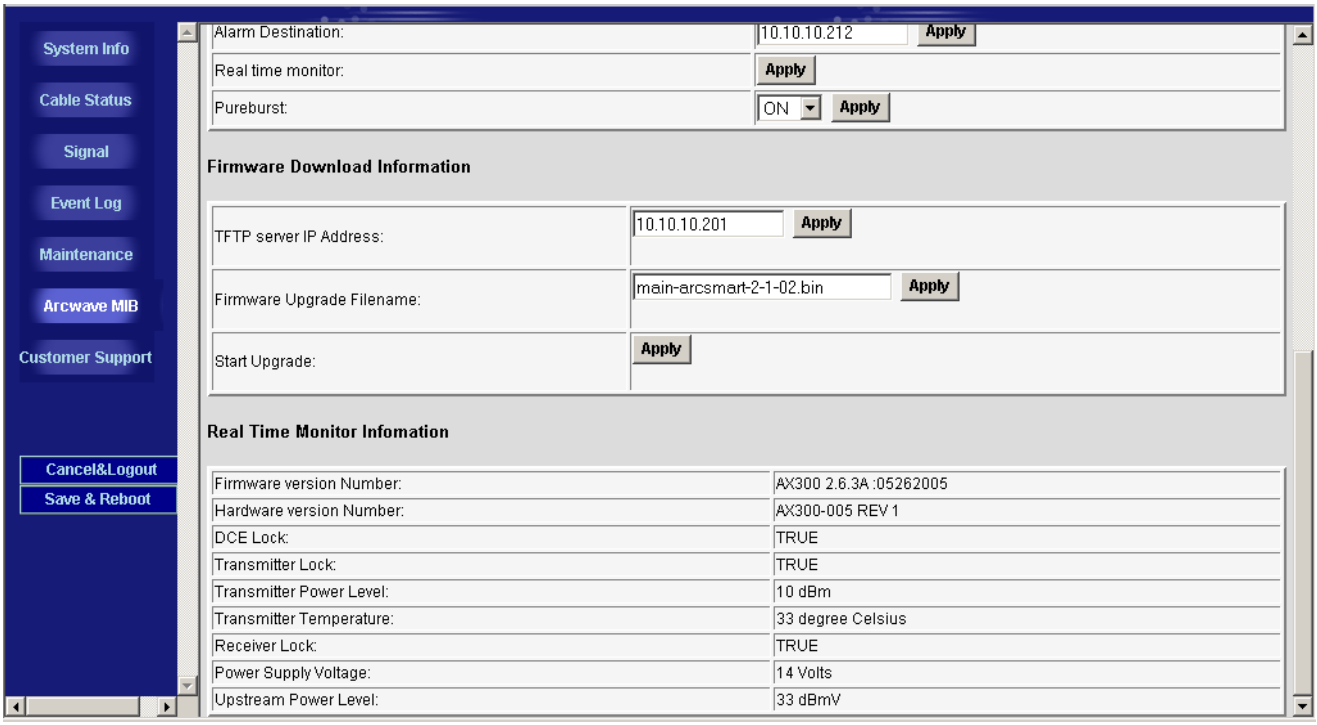


Figure 5-8: Arcwave MIB page – Bottom

Firmware Download Information

TFTP server IP Address	Enter the TFTP (Trivial File Transfer Protocol) server’s IP address.
Firmware Upgrade Filename	Enter the file name of the ARCSmart controller (AR300 Module) firmware to be downloaded to the Hub.
Start Upgrade	Click the “Apply” button to initiate the download. The download of the new controller firmware will take up to two minutes. The download can be verified by refreshing the page. The version number of the downloaded firmware should be displayed in the Firmware Version Number box under in the Real Time Monitor Information table.

Arcwave MIB Real Time Monitor Information

Firmware Version Number:	Displays the ARCSmart firmware version number.
Hardware Version Number:	Displays the ARCSmart AR300 module hardware revision number.

DCE Lock:	Displays the status of the PLL (Phase Lock Loop) in the AR300 module. It will display “TRUE” if the Hub if the PLL is working properly and “FALSE” if it is not.
Transmitter Lock:	Displays the status of the Hub wireless transmitter. It will display “TRUE” if the Hub is tuned to transmit at the downstream wireless carrier frequency.
Transmitter Power Level:	Displays the power level of the Hub wireless transmitter into the antenna.
Transmitter Temperature:	Displays the temperature in degrees Celsius at the surface of the Hub wireless transmitter module.
Receiver Lock:	Displays the status of the Hub wireless receiver. It will display “TRUE” if the Hub is tuned to receive at the upstream wireless carrier frequency.
Power Supply Voltage:	Displays the DC voltage at the ARCSmart AR300 module. It indirectly reflects the status of the AC adaptor.
Upstream Power Level:	Displays the approximate upstream transmit power level. It is the upstream transmit power level of the ECM minus 10 dBmV.

HUB UPGRADE PROCEDURE

Via HTTP Interface

1. Upgrade ECM software to new version using your normal cable modem upgrade procedure. Verify empty pull down menus in Arcwave MIB page.

2. Upgrade AR300 (ARCSmart) firmware using the Firmware Download utility on the Arcwave MIB page.

3. Select "Reset To Factory Defaults" on the Maintenance page.

4. After CM resets and becomes operational, verify pull down menus in Arcwave MIB page are functional.

Via SNMP Interface

1. Upgrade ECM software to new version using your normal cable modem upgrade procedure. Verify empty pull down menus in Arcwave MIB page.

2. Upgrade AR300 (ARCSmart) firmware using the Firmware Download utility on the Arcwave MIB page.

3. Set "factoryReset" OID to "true" (1) in admin table within Arcwave MIB.

Via ARCNet

1. Upgrade ECM software to new version using your normal cable modem upgrade procedure. Verify empty pull down menus in Arcwave MIB page.

2. Upgrade AR300 (ARCSmart) firmware (refer to ARCNet User Guide for instructions on how to do this in real time - Do NOT Schedule an upgrade for later).

3. Select "Reset To Factory Defaults" on the Maintenance page Accessories

ARCXTEND ACCESSORIES

The following accessories are available from Arcwave to use with the ARCXtend solution. To purchase accessories, contact your sales representative.

- AR100 Signal Strength Meter – For use in CPE alignment.

Figure 6-1: AR100 Signal Strength Meter

SPECIFICATIONS

AX1455 Network Hub

Wireless Channels	Downstream: 20, 6.0 MHz Channels Upstream: 14, 3.2 MHz Channels 7, 6.4 MHz Channels
Wireless Frequency Range	(TX) 5.813 to 5.843 GHz; (RX) 5.725 to 5.742 GHz
Maximum Transmit Output Power	High: +15 dBm (Note: The "High" power setting is for use with the AX1455-SM-90, AX1455-SM-60 and AX1455-VM-90 Network Hubs. Use of the "High" power setting with the AX1455-SM-25 cancels the FCC certification and voids the user's authority to operate the unit in the 5.8 GHz band.) Medium: +9 dBm Low: -1 dBm
RF Frequency Range	90 to 860 MHz (Downstream); 5 to 42 MHz (Upstream)
D/S Modulation Supported	64 QAM, and 256 QAM
U/S Modulation Supported	QPSK, 16 QAM, and 64 QAM
D/S Input Signal Level into the Hub	0 to +30 dBmV
U/S Output Signal Level out of the Hub	+35 dBmV Typical
U/S Receiver Noise Figure	5.0 dB Typical
Adjacent Channel Rejection	Greater than 40 dB
	AX1455-SM-60 AX1455-SM-25
Horizontal Beamwidth (–3 dB)	60° 20°
Vertical Beamwidth (-3 dB)	18° 18°
Transmit Gain	15 dBi 19 dBi
Receive Gain	14 dBi 16 dBi
Network Management	
MIB	SNMP MIB (Alarms, Parameters, Metrics)
Remote	SNMP or HTTP-bases User Interface
Local	HTTP-bases User Interface
Services Supported	DOCSIS, Digital and Analog Video, CBR Voice, T1/E1
Input Power	60 or 90 Vac nominal; 50 to 110 Vac actual; or +24 Vdc
Internal Operating Power	+24 Vdc nominal
Power Dissipation	24 Watts Maximum (at 90Vac)
Operating Temperature Range	–40°C to +65°C
Operating Humidity	100% condensing
Protocols	SNMP v1/2/3, DOCSIS 2.0
Regulatory	FCC, IC (Canada)
Connections	DC Power and Data port RJ-45 Cable port F-Type female -20 dB Monitor port F-Type female
Dimensions and Weight	AX1455-SM-60/25 17" x 7.5" x 5.6", 8.2 lbs.

Table 7-1: AX1455 Specifications

AX3255 Customer Premise Antenna / Transceiver (CPE)

Wireless Channels	Downstream: 6, 6.0 MHz Channels Upstream: 11, 3.2 MHz Channels
Wireless Frequency Range	(TX) 5.813 to 5.843 GHz; (RX) 5.725 to 5.742 GHz
Maximum Transmit Output Power	+36 dBm EIRP Maximum
Receiver Noise Figure	Less than 5.0 dB typical
DOCSIS Frequency Range	90 to 150 MHz (Downstream); 5 to 42 MHz (Upstream)
Downstream Modulation Supported	64 QAM and 256 QAM
Upstream Modulation Supported	QPSK, 16 QAM, and 64 QAM
Upstream Input Signal Level	+25 to +58 dBmV
Downstream Output Signal Level	Variable, based on link distance; +20 dBmV Typical
Minimum Downstream Input Signal Level to the Cable Modem	64 QAM: -15 to +15 dBmV 256 QAM: -6 to +15 dBmV
Receiver Noise Figure	3 dB Typical
Antenna	
Horiz. Tx Beamwidth (3 dB) Vertical Tx Beamwidth (-3 dB) Transmit Gain Receive Gain	10° 20° 14 dBi 22 dBi
Mechanical, System, and Regulatory	
Input Power	120 Vac Power Pack
Operating Power	18 Vdc Power over Coax
Maximum Distance from CPE to Power Pack	300 feet
Power Dissipation	5 Watts Maximum
Operating Temperature Range	–40°C to +65°C
Operating Humidity	100% condensing
Regulatory	FCC, IC (Canada)
Mounting	1-1/4” to 2-3/8” Pipe
Connections	Cable port F-Type female
Dimensions and Weight	14-5/8” x 14-5/8” x 2-3/8”, 5.1 lbs.

Table 7-2: AX3255 Specifications

Environment Specifications

The environmental specifications for the ARCXtend solution including the AX1455, AX3255 and associated electrical and mechanical subassemblies are given in Table 7-3 below.

Requirement	Specification
Altitude	
Operating	Low to 10,000 feet
Storage and Transportation	Low to 50,000 feet
Ambient Temperature	
Operating	–40 to +65°C (Includes solar loading)
Storage	–60 to +75°C
Humidity	
Operating	5 to 100% RH Non-condensing
Storage	5 to 95% RH
Rain	
Operating	Wind driven rain of 5.8 in/hour at 70 MPH May not cause a link outage, but can degrade performance)
Survival	No requirement
Water immersion	No leaks at 15 PSI internal pressure for 10 seconds
Salt Spray	Per Specification – Comcast 1000 hrs.
Wind	
Operating (Hub):	112 MPH (180km/hr) with 1 inch radial ice May not cause a link outage, but can degrade performance. The deviation of the antenna main beam axis should not be more than 0.3 times the smaller of the two azithumal and elevation HPBW as a general rule)
Survival (Hub)l:	125 MPH (200km/hr) No significant loss of alignment after test
Vibration	
Operating:	0.001 G^2/Hz from 5-100 Hz (IEC 60068-2-6)
Survival:	0.01 G^2/Hz from 5-100 Hz (IEC 60068-2-6)
Shock	
Survival:	IEC 60068-2-27
Packaged:	4 Ft. drop
Corrosion	
Plated Surfaces:	ASTM D-2247, ASTM B-117/DIN 75-302
Painted Surfaces:	ASTM 117-B (Salt Spray), ASTM D3359, ASTM-D4060
UV Resistance/Stability	ASTM G-53/DIN 53-505
Lightning/ESD	20kA IEC 1000-4-5 8/20µs Waveform
Surge Withstand Capability (Hub)	CAT B3 6kV, 3kA Combination wave on all RF ports CAT A3 6kV, 200A Ring Wave on DC power Port CAT B3 6kA Combination wave on 120 Vac Transformer Input

Table 7-3 Environmental Specifications

ARCWAVE ENTERPRISE MIB R2.1

This guide describes Arcwave Enterprise Management Information Base (Arcwave MIB) Release 2.1. The Arcwave Enterprise MIB is included in all ARCXtend Network Hubs.

The MIB file contains variables that can be set or read to provide information on network devices and interfaces. The Arcwave MIB is a set of variables that are private extensions to the Internet standard MIB II. The MIB II is documented in RFC 1213; Management Information Base for Network Management of TCP/IP based Internets: MIB-II.

The listing of Arcwave MIB variables in the Arcwave.mib text file is identical to the listing of Arcwave MIB variables in this guide. The Arcwave.mib file is included on each product documentation CD and can also be obtained from Arcwave technical support.

The Arcwave MIB variables are accessible via the Simple Network Management Protocol (SNMP), which is an application-layer protocol designed to facilitate the exchange of management information between network devices.

Arcwave Enterprise MIB R2.1 Structure

The Arcwave MIB, named ArcwaveMib has the following structure:

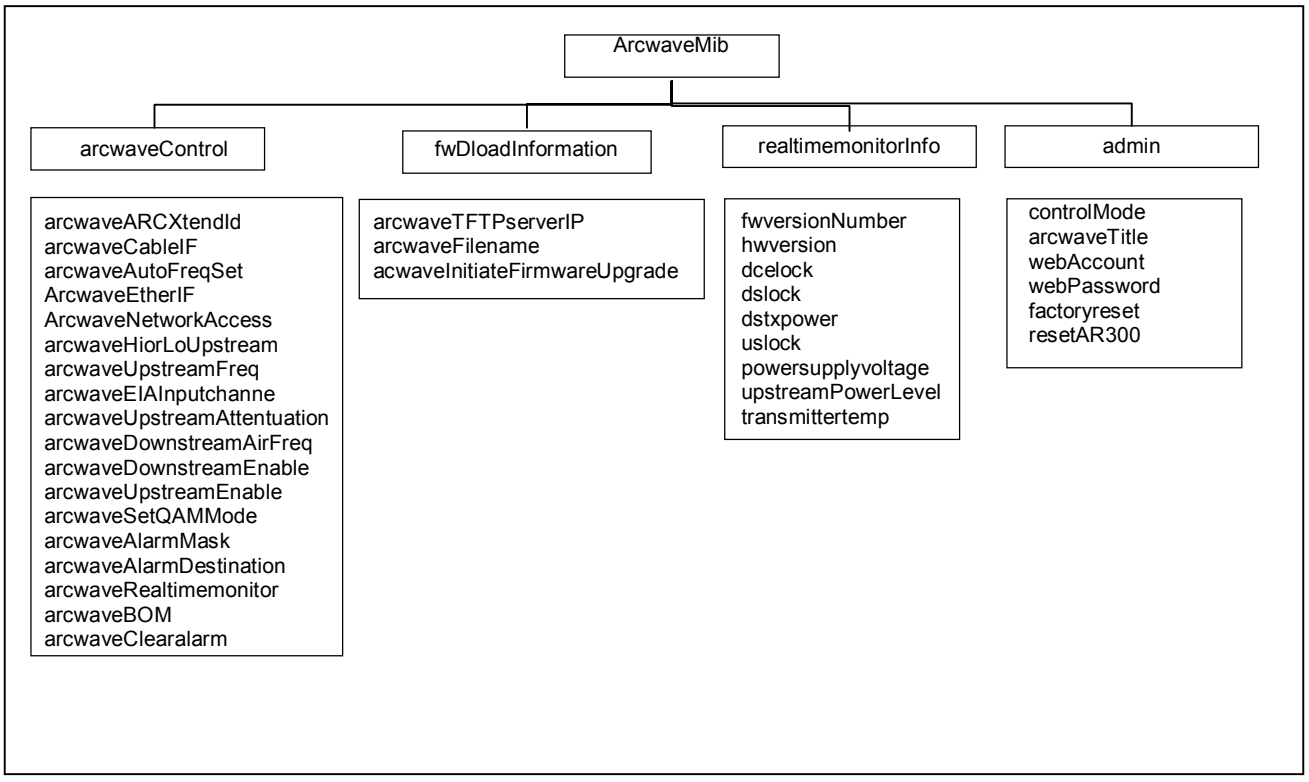


Figure A-1 Arcwave MIB Structure

Arcwave Enterprise 2.1 MIB Element Definitions

Element	Object Identifier	Address	Description	Values	Syntax	Access	Status	Default
productType	arcwaveMIB 1	1.3.6.1.4.1.18482						
arcwaveControl	productType 12	1.3.6.1.4.1.8595.1.12						
arcwaveARCXtendId	arcwaveControl 1	1.3.6.1.4.1.8595.1.12.1	This element indicates the ARCXtend Hub type.	01 = AX1455 02 – AX1455 Standard Band 03 – AX1455 Extended Band 04 – AX1555 05 – AX1655 06 – AX1755	Integer	Read Only	Current	01
arcwaveCableIF	arcwaveControl 2	1.3.6.1.4.1.8595.1.12.2	This element turns the cable interface of the ECM on or off. When the interface is turned on, the ECM will continually look for a downstream cable channel.	0 = Enable 1 = Disable	Integer	Read/Write	Current	Enable
arcwaveAutoFreqSet	arcwaveControl 3	1.3.6.1.4.1.8595.1.12.3	This element enables or disables the automatic setting of arcwaveEIAInputchannel and arcwaveUpstreamFreq.	0 = Disable 1 = Enable	Integer	Read/Write	Current	Enable
arcwaveEtherIF	arcwaveControl 4	1.3.6.1.4.1.8595.1.12.4	This element enables or disables the local Ethernet interface	0 = Disable 1 = Enable	Integer	Read/Write	Current	Enable
arcwaveNetworkAccess	arcwaveControl 5	1.3.6.1.4.1.8595.1.12.5	This element enables or disables local access to the Cable IP network.	0 = Disable 1 = Enable	Integer	Read/Write	Current	Disable
arcwaveHiorLoUpstream	arcwaveControl 6	1.3.6.1.4.1.8595.1.12.6	This element tells the Hub to tune to one of the two upstream wireless carrier pairs. The upstream DOCSIS channel is transmitted by the ArcWave CPE simultaneously on two	1 = High 2 = Low	Integer	Read/Write	Current	Low

			frequencies: 1 = arcwaveUpstreamFreq + DOCSIS upstream frequency 2 = arcwaveUpstreamFreq - DOCSIS upstream frequency (in MHz) This element is included for possible future support of frequency diversity. It can also be used when interference is experienced one of the two channels.					
arcwaveUpstreamFreq	arcwaveControl 7	1.3.6.1.4.1.8595.1.12.7	This element contains the upstream wireless frequency (in MHz) that is being used. The BRM-3520 Cable Modem programs the AR300 Extender Module with this value based on its assigned upstream DOCSIS channel. There is a one-to-one relationship between the upstream wireless frequency and the upstream DOCSIS channel.	6.4 to 48 in 0.1 increments(in MHz) Valid range for AX1455 is 6.4 to 48 and for AX1455 is 10 to 48	Integer32	Read Only	Current	N/A
arcwaveEIAInputchannel	arcwaveControl 8	1.3.6.1.4.1.8595.1.12.8	This element displays the downstream channel that is being used. The BRM-3520 Cable Modem programs the AR300 Extender Module with this value based on its downstream channel.	See Appendix A for a listing of EIA channel numbers and associated frequencies	Integer32	Read-Only	Current	N/A
arcwaveUpstreamAttentuation	arcwaveControl 9	1.3.6.1.4.1.8595.1.12.9	This element sets the gain on the upstream receiver. The higher the value the more attenuation is applied to the upstream receiver. Increasing the attenuation	0 to 64 (in dB) and 99. When set to 99, the gain will be set automatically	Integer32	Read/Write	Current	99

			reduces ingress noise onto the cable plant, but also decreasing the upstream wireless range.					
arcwaveDownstreamAirFreq	arcwaveControl 10	1.3.6.1.4.1.8595.1.12.10	This element sets the downstream wireless channel to be used. (in MHz)	For AX1455: 5813, 5819, 5825, 5831, 5837 and 5843	Integer32	Read/Write	Current	N/A
arcwaveDownstreamEnable	arcwaveControl 11	1.3.6.1.4.1.8595.1.12.11	This element turns on the downstream wireless transmitter in the Hub.	1 = true 2 = false	Integer	Read/Write	Current	False
arcwaveUpstreamEnable	arcwaveControl 12	1.3.6.1.4.1.8595.1.12.12	This element turns on the upstream wireless receiver in the Hub.	1 = true 2 = false		Read/Write	Current	False
arcwaveSetQAMMode	arcwaveControl 13	1.3.6.1.4.1.8595.1.12.13	This element selects the Downstream Power Setting: High, Medium or Low.	0 = High 1 = Medium 3 = Low	Integer	Read/Write	Current	Low
arcwaveAlarmMask	arcwaveControl 14	1.3.6.1.4.1.8595.1.12.14	Sets the alarm mask for the AR300 module. All 0's masks all alarms, all F's lets all alarms through, values in between will mask the corresponding alarm.	0000 to FFFF	SnmpAdminString	Read/Write	Current	FFFF
arcwaveAlarmDestination	arcwaveControl 15	1.3.6.1.4.1.8595.1.12.15	Sets the IP address of the SNMP Traps Monitor. SNMP traps are sent to this address when control mode is set to "HTTP"	IP Address	IpAddress	Read/Write	Current	0.0.0.0
arcwaveRealtimemonitor	arcwaveControl 16	1.3.6.1.4.1.8595.1.12.16	Fetches Real Time Monitoring information from the ArcXtend Hub	1 = true 2 = false	Integer	Read/Write	Current	2
arcwaveBOM	arcwaveControl 17	1.3.6.1.4.1.8595.1.12.17	This element turns PureBurst ingress noise suppression on or off	0 = Off 1 = On	Integer	Read/Write	Current	On
arcwaveClearalarm	arcwaveControl 18	1.3.6.1.4.1.8595.1.12.18	Clears alarms	1 = true 2 = false	Integer	Read/Write	Current	2
fwDloadInformation	productType 14							

arcwaveTFTPserverIP	fwDloadInformation 1	1.3.6.1.4.1.8595.1.14.1	This element sets the IP address of the TFTP server that will be used for firmware download.		IP Address	Read/Write	Current	0.0.0.0
arcwaveFilename	fwDloadInformation 2	1.3.6.1.4.1.8595.1.14.2	This element sets the file name of the firmware to be downloaded to the Hub.	255 character alpha numeric string	SnmpAdminString	Read/Write	Current	N/A
acwaveInitiateFirmWareUpgrade	fwDloadInformation 3	1.3.6.1.4.1.8595.1.14.3	This element tells the Hub to initiate a firmware upgrade.	1 = true 2 = false	Integer	Read/Write	Current	N/A
realtimemonitorInfo	productType 15							
fwversionNumber	realtimemonitorInfo 1	1.3.6.1.4.1.8595.1.15.1	This element contains the firmware version number	40 character alpha numeric string	SnmpAdminString	Read-Only	Current	N/A
hwversion	realtimemonitorInfo 2	1.3.6.1.4.1.8595.1.15.2	This element contains the hardware version number	40 character alpha numeric string	SnmpAdminString	Read-Only	Current	N/A
dcelock	realtimemonitorInfo 3	1.3.6.1.4.1.8595.1.15.3	This element indicates the status of the PLL on the AR300 module.	1 = true 2 = false	Integer	Read/Write	Current	N/A
dslock	realtimemonitorInfo 4	1.3.6.1.4.1.8595.1.15.4	This element indicates the status of the Hub Transmitter Module. A”true” will be displayed if the module is active.	1 = true 2 = false	Integer	Read/Write	Current	N/A
dstxpower	realtimemonitorInfo 5	1.3.6.1.4.1.8595.1.15.5	This element contains the downstream transmit power out of the Hub Transmitter Module. (in dBmv)	0 to 99	Integer	Read-Only	Current	
uslock	realtimemonitorInfo 6	1.3.6.1.4.1.8595.1.15.6	This element indicates the status of the Hub Receiver Module. A ”true” will be displayed if the module is active.	1 = true 2 = false	Integer	Read-Only	Current	N/A
powersupplyvoltage	realtimemonitorInfo 7	1.3.6.1.4.1.8595.1.15.7	This element contains the DC output voltage of the Hub AC power supply as read from the Extender Module.	0 to 30	Integer	Read-Only	Current	N/A
txpowerlevel	realtimemonitorInfo 8	1.3.6.1.4.1.8595.1.15.8	This element reports the approximate upstream transmit power level of the	0 to 99	Integer	Read-Only	Current	N/A

			hub. Its value is the upstream transmit power level of the ECM- 10). (in dBmv)					
transmittertemp	realtimemonitorInfo 9	1.3.6.1.4.1.8595.1.15.9	This element contains the temperature at the surface of the Hub transmitter module in degrees Celsius.	-40 to 99	Integer	Read-Only	Current	N/A
admin	productType 17							
controlMode	admin 1	1.3.6.1.4.1.8595.1.17.1	This element sets the management mode for the Hub.	1 = SNMP 2 = HTTP	Integer	Read/Write	Current	1
arcwaveTitle	admin 2	1.3.6.1.4.1.8595.1.17.1	This element can be used to assign a Hub name.	40 character alpha numeric string	SnmpAdminString	Read/Write	Current	MAC address of ECM
webAccount	admin 3	1.3.6.1.4.1.8595.1.17.2	This element contains the user account name for the HTTP Interface.	40 character alpha numeric string	SnmpAdminString	Read/Write	Current	N/A
webPassword	admin 4	1.3.6.1.4.1.8595.1.17.3	This element contains the user account password for the HTTP Interface.	40 character alpha numeric string	SnmpAdminString	Read/Write	Current	N/A
factoryreset	admin 5	1.3.6.1.4.1.8595.1.17.4	This elements restores the factory default settings to the AR300 MIB.	1 = true 2 = false	Integer	Read/Write	Current	N/A
resetAR300	admin 6	1.3.6.1.4.1.8595.1.17.5	This element resets the AR300 module.	1 = true 2 = false	Integer	Read/Write	Current	N/A

Table A-1 Arcwave MIB Definitions and OID

Arcwave Alarm Descriptions

Event Syntax	Event Message Text	Severity	Customer Symptom	Explanation of event /Corrective Action	What will the Customer Experience
AR300 System Lock Lost	The Unit has lost lock in the Upstream or Downstream	Critical	Modems on the ARCXtend system lose sync	The transmitter or receiver module (or both) has lost lock. From the NOC, clear alarm and reset the Hub using the Reset ARCXtend command located on the ARCXtend Maintenance page. If this doesn't clear up the problem then refer problem to the field for local troubleshooting. In the field, reset power on unit & check if condition goes away. If not troubleshoot accordingly.	Lost of traffic, system outage
AR300 Hub Dead	The Unit is dead.	Critical	Modems on the ARCXtend system lose sync	The transmitter or receiver module or both stop communicating with the control module. From the NOC, clear alarm and reset the Hub using the Reset ARCXtend command located on the ARCXtend Maintenance page. If this doesn't clear up the problem then refer problem to the field for local troubleshooting. In the field, reset power on unit & check if condition goes away. If not troubleshoot accordingly.	Lost of traffic, system outage
AR300 Input voltage outside of tolerance	Voltage level is either below or above tolerance limits	Major	This alarm gets displayed	The voltage being supplied to the Unit is improper. From the NOC, clear alarm and reset the Hub using the Reset ARCXtend command located on the ARCXtend Maintenance page. If this doesn't clear up the problem then refer problem to the field for local troubleshooting. In the field, reset power on unit & check if condition goes away. If not troubleshoot accordingly.	No immediate impact but could result in loss of traffic, system outage.
Warning: The Hub is operating within 10C of its maximum operating temperature.	The Unit is operating near its maximum operating temperature	Major	This alarm gets displayed	The Unit is operating near its maximum operating temperature. At the NOC check temperature and clear alarm. If this doesn't clear up the problem then refer problem to the field for local troubleshooting. In the field, shade hub using a sun shield or relocate to a new location.	No immediate impact but could result in loss of traffic, system outage.

Event Syntax	Event Message Text	Severity	Customer Symptom	Explanation of event /Corrective Action	What will the Customer Experience
AR300 DCE Unlocked or Error	The Control module has lost lock	Critical	Modems on the ARCXtend system lose sync	The Control module has lost lock. From the NOC, clear alarm and reset the Hub using the Reset ARCXtend command located on the ARCXtend Maintenance page. If this doesn't clear up the problem then refer problem to the field for local troubleshooting. In the field, reset power on unit & check if condition goes away. If not troubleshoot accordingly.	Lost of traffic, system outage
AR300 Upstream (Receiver) Unlocked or Error"	The Upstream module has lost lock.	Critical	Modems on the ARCXtend system lose sync	The Upstream module has lost lock. From the NOC, clear alarm and reset the Hub using the Reset ARCXtend command located on the ARCXtend Maintenance page. If this doesn't clear up the problem then refer problem to the field for local troubleshooting. In the field, reset power on unit & check if condition goes away. If not troubleshoot accordingly.	Lost of traffic, system outage
AR300 Downstream(Transmitter) Unlocked or Error	The Downstream module has lost lock.	Critical	Modems on the ARCXtend system lose sync	The Downstream module has lost lock. From the NOC, clear alarm and reset the Hub using the Reset ARCXtend command located on the ARCXtend Maintenance page. If this doesn't clear up the problem then refer problem to the field for local troubleshooting. In the field, reset power on unit & check if condition goes away. If not troubleshoot accordingly.	Lost of traffic, system outage
Local Parameter Modification Notification	There has been a change in the parameters on the control module	Normal	A change in parameters is made via CLI or by the control module	There has been a change in the parameters on the control module/ Do nothing - it's an informative alarm	No impact, informational only. Note changes made via CLI may be reset upon reboot of unit.

Table A-2 Arcwave Alarm Definitions

Arcwave Traps

Unique Trap OID	Syntax Type	Description	Enumeration(s)/Example(s)
1.3.6.1.4.1.18482.1.16.0.1	Integer	Alarm ID	1
	String	Alarm Description	System Lock Lost
		Alarm Action	Critical
1.3.6.1.4.1.18482.1.16.0.2	Integer	Alarm ID	2
	String	Alarm Description	Hub Dead
		Alarm Action	Critical
1.3.6.1.4.1.18482.1.16.0.3	Integer	Alarm ID	3
	String	Alarm Description	Input voltage outside of tolerance
		Alarm Action	Major
1.3.6.1.4.1.18482.1.16.0.4	Integer	Alarm ID	4
	String	Alarm Description	Warning: the Hub is operating within 10C of its maximum operating temperature.
		Alarm Action	Major
1.3.6.1.4.1.18482.1.16.0.5	Integer	Alarm ID	5
	String	Alarm Description	DCE Unlocked or Error
		Alarm Action	Critical
1.3.6.1.4.1.18482.1.16.0.6	Integer	Alarm ID	6
	String	Alarm Description	Upstream (Receiver) Unlocked or Error
		Alarm Action	Critical
1.3.6.1.4.1.18482.1.16.0.7	Integer	Alarm ID	7
	String	Alarm Description	Downstream(Transmitter) Unlocked or Error
		Alarm Action	Critical
1.3.6.1.4.1.18482.1.16.0.8	Integer	Alarm ID	8
	String	Alarm Description	Local Parameter Modification Notification
		Alarm Action	Normal

Table A-3 Arcwave Traps

Sample Trap Format

Here is a capture of trap #2:

```
No.     Time        Source                Destination           Protocol Info
3       4.067514    192.168.2.74          10.10.10.6            SNMP     TRAP-V1
Frame 3 (88 bytes on wire, 88 bytes captured)
Ethernet II, Src: 00:30:b8:80:2b:1f, Dst: 00:0d:56:6e:d6:d7
Internet Protocol, Src Addr: 192.168.2.74 (192.168.2.74), Dst Addr: 10.10.10.6 (10.10.10.6)
User Datagram Protocol, Src Port: 1029 (1029), Dst Port: snmptrap (162)
Simple Network Management Protocol
   Version: 1 (0)
   Community: public
   PDU type: TRAP-V1 (4)
```

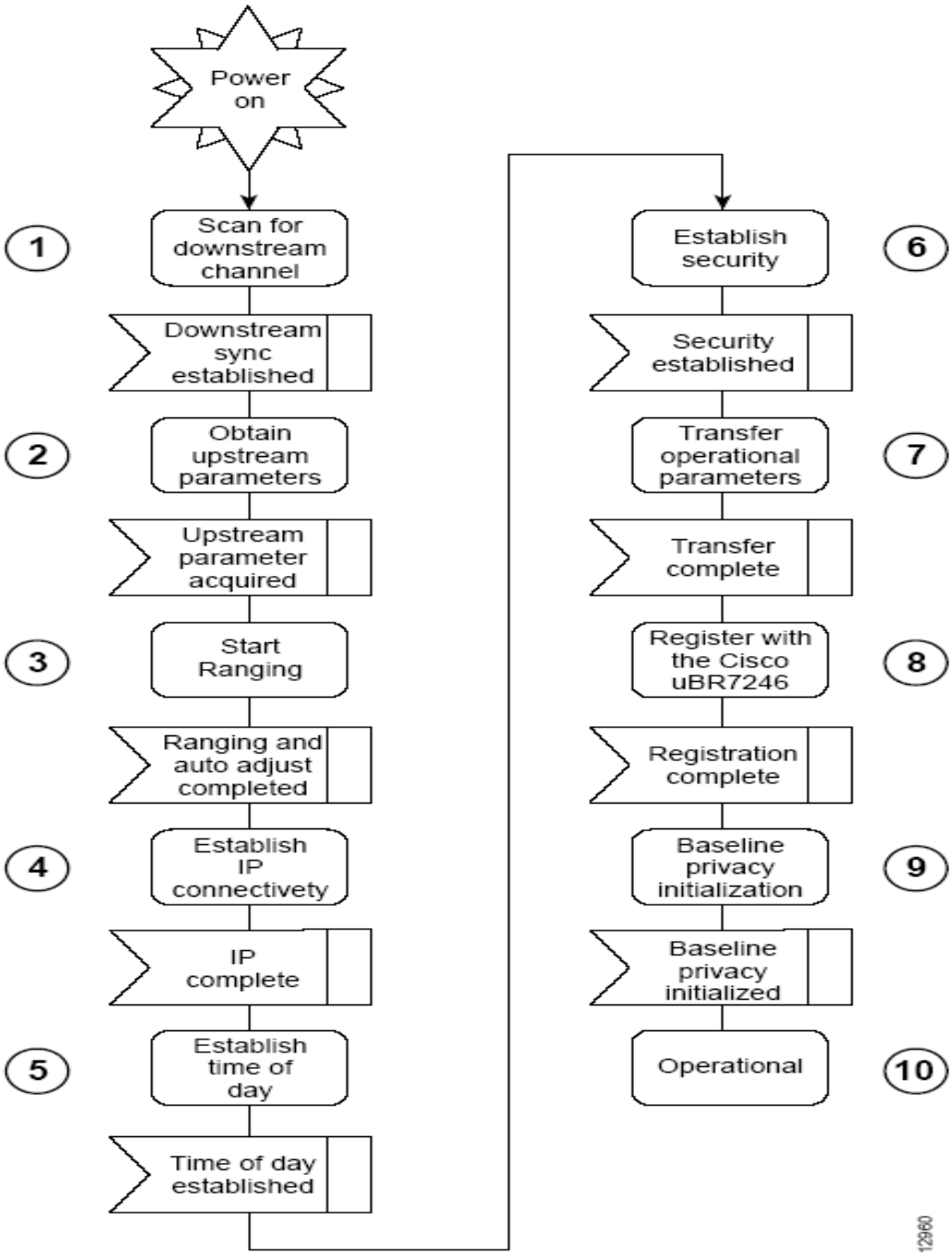
Enterprise: 1.3.6.1.4.1.18482.1.16 (iso.3.6.1.4.1.18482.1.16)
Agent address: 0.0.0.0 (0.0.0.0)
Trap type: ENTERPRISE SPECIFIC (6)
Specific trap type: 2
Timestamp: 34600

arcwaveEIAInputchannel VALUES

EIA Ch.	Freq. in MHz	EIA Ch.	Freq. in MHz	EIA Ch.	Freq. in MHz
95	93	46	357	90	621
96	99	47	363	91	627
97	105	48	369	92	633
98	111	49	375	93	639
99	117	50	381	94	645
14	123	51	387	100	651
15	129	52	393	101	657
16	135	53	399	102	663
17	141	54	405	103	669
18	147	55	411	104	675
19	153	56	417	105	681
20	159	57	423	106	687
21	165	58	429	107	693
22	171	59	435	108	699
7	177	60	441	109	705
8	183	61	447	110	711
9	189	62	453	111	717
10	195	63	459	112	723
11	201	64	465	113	729
12	207	65	471	114	735
13	213	66	477	115	741
23	219	67	483	116	747
24	225	68	489	117	753
25	231	69	495	118	759
26	237	70	501	119	765
27	243	71	507	120	771
28	249	72	513	121	777
29	255	73	519	122	783
30	261	74	525	123	789
31	267	75	531	124	795
32	273	76	537	125	801
33	279	77	543	126	807
34	285	78	549	127	813
35	291	79	555	128	819
36	297	80	561	129	825
37	303	81	567	130	831
38	309	82	573	131	837
39	315	83	579	132	843
40	321	84	585	133	849
41	327	85	591	134	855
42	333	86	597	135	861
43	339	87	603	136	867
44	345	88	609	137	873
45	351	89	615	138	879

CABLE MODEM INITIALIZATION

The sequence numbers shown in Figure B-1 are explained in Table B-1, which appears after the illustration. The cable modem will complete all the steps in this flowchart each time it needs to reestablish ranging and registration with the CMTS.



Sequence	Event	Description
1	Scan for a downstream channel and establish synchronization with the CMTS.	The cable modem acquires a downstream channel from the CMTS and saves the last operational frequency in non-volatile memory. The cable modem tries to reacquire the saved downstream channel the next time a request is made. **Note** An ideal downstream signal is one that synchronizes QAM symbol timing, FEC framing, MPEG packetization, and recognizes downstream sync MAC layer messages.
2	Obtain upstream channel parameters.	The cable modem waits for an upstream channel descriptor (UCD) message from the CMTS. The UCD provides transmission parameters for the upstream channel.
3	Start ranging for power adjustments.	The ranging process adjusts the cable modem's transmit power.
4	Establish IP connectivity.	The cable modem sends a DHCP request to obtain an IP address, which is needed for IP connectivity. The DHCP response also includes the name of a file that contains additional configuration parameters, the TFTP server's address, and the Time of Day (TOD) server's address.
5	Establish the time of day.	The cable modem accesses the TOD server for the current date and time, which is used to create time stamps for logged events (such as those displayed in the MAC log file).
6	Establish security.	Keys for privacy are exchanged between the cable modem and the CMTS.
7	Transfer operational parameters.	After the DHCP and security operations are successful, the cable modem downloads operational parameters from a configuration file stored on the cable company's TFTP server.
8	Comply with baseline privacy.	If the software image running on the cable modem includes baseline privacy, link level encryption keys are exchanged between the CMTS and the cable modem.
9	Enter the operational maintenance state.	As soon as the cable modem has successfully completed above sequence, it enters operational maintenance state.

Table B-1 Cable Modem Initialization Steps