ARCXtend™ Wireless Plant Extension Solution

5.8 GHz / 5.3 GHz Operation

User Manual

R1.4 Issue 4

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REVISION HISTORY

ISSUE #	AUTHOR	CHECK OUT	CHECK IN	COMMENTS
0.5	CM		09/21/2004	R1.4 DRAFT - DOCUMENT IN PROCESS
1.3	CM	10/25/04	12/07/04	R.14 ISSUE 1.3 – INCORPORATED EDITS
4	CM	12/22/04	01/07/05	R1.4 ISSUE 4 UPDATED HUB POWER CONSUMPTION SPECIFICATION UPDATE DS RANGE SPECIFICATIONS CHANGED POWER INSERTER DIAGRAM, UPDATED HUB TX POWER AND GAIN VALUES REMOVED INDUSTRY CANDA CERTIFICATION CHANGED FCC CERTIFICATION FROM CLASS B TO CLASS A ADDED NOTE THAT HIGH POWER TRANMIST MODE IS FOR USE WITH AX1255-VM-90 AND AX1255-SM-90 HUBS ADDED NOTE THAT THE DOWNSTREAM POWER LEVEL INTO THE CABLE MODEM WITH 256 QAM OPERATION IS -6 TO +15 DBMV. ADDED MAXIMUM DISTANCE OF 300 FEET FROM CPE TO 18 VDC POWER PACK UPDATED DEFAULT UPSTREAM BAND SETTING TABLE ADDED PART 15, SECTION 15.21 USERS WARINING.

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. In Canada, users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5650 – 5850 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

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.

WARNING (Part 15, Section 15.21)

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: PLRAX1255

FCC Identifier: PLRAX3155

RF Exposure

CAUTION: To ensure compliance with FCC RF exposure requirements, the antenna used for this device must be installed to provide a separation distance of at least 20 cm from all persons and must not be located or operated in conjunction with any other antenna or radio transmitter.

http://www.arcwaveinc.com

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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.

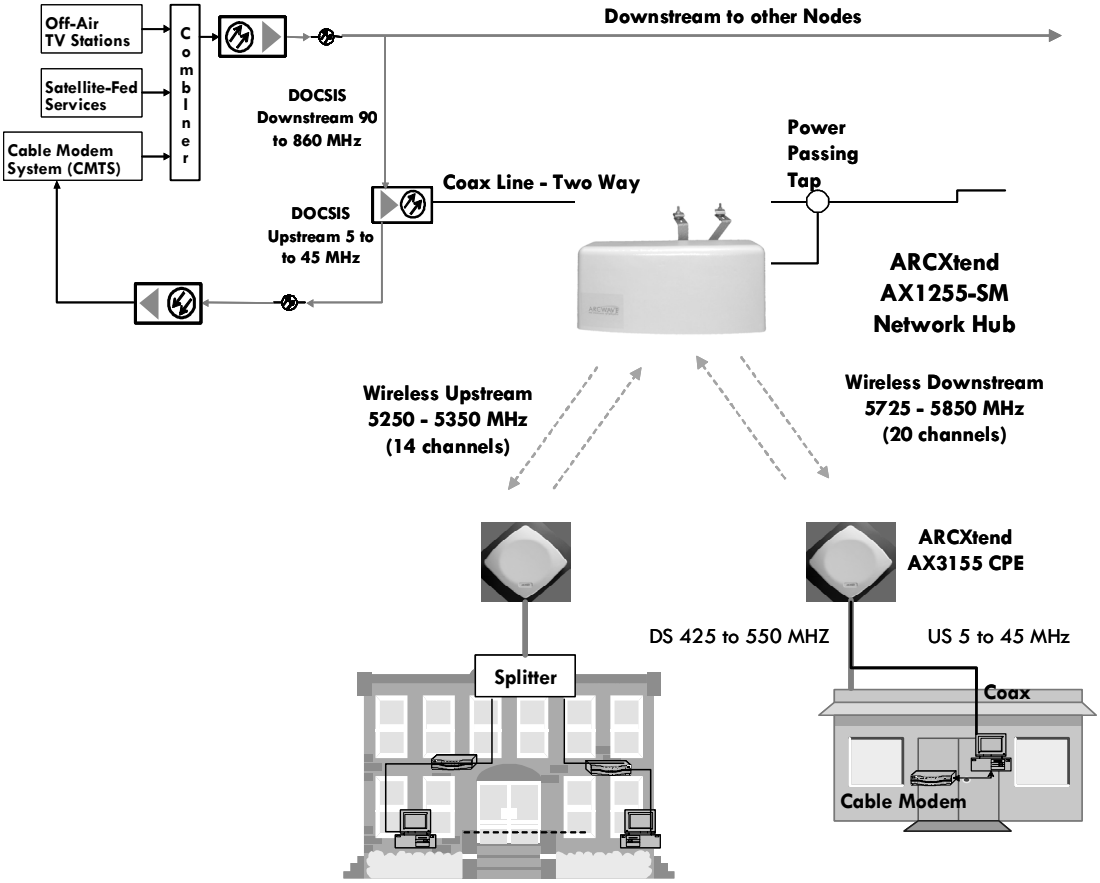


Figure 2-1: ARCXtend Solution Architecture

System Configuration

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

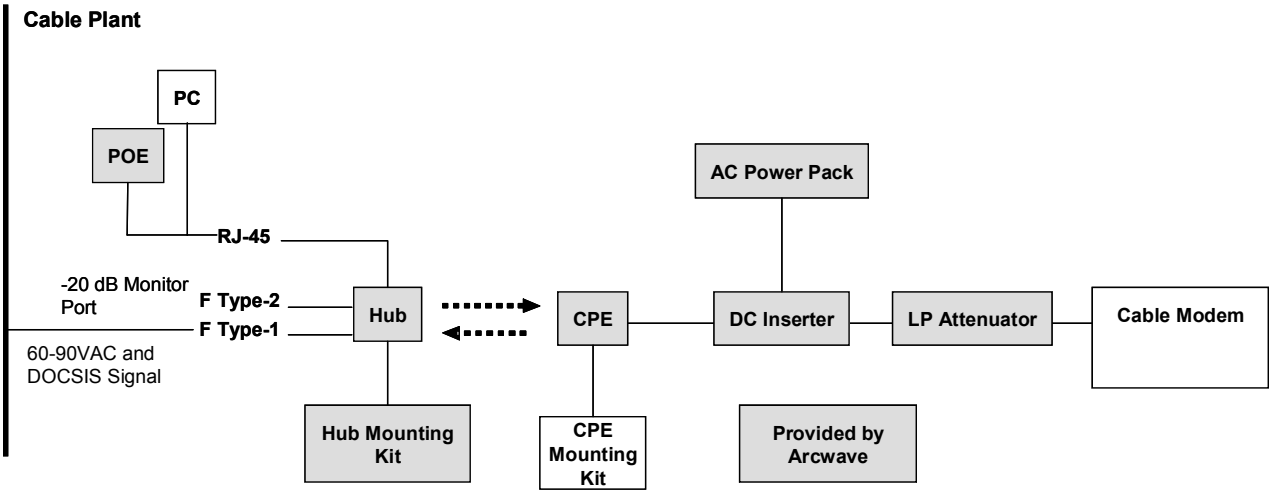


Figure 2-2: ARCXtend Solution Elements

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 upconverts it to a selected wireless carrier frequency in the 5,725 to 5,850 MHz 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 downconverts it to an RF channel in the range 425 to 550 MHz (the specific value is wireless carrier frequency minus 5300 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 upconverts it to a pair of fixed frequencies (one high computed as 5,300 MHz plus the RF signal frequency, one low computed as 5,300 minus the RF signal frequency) in the range 5,250 to 5,350 MHz.

The Hub receives the wireless signal and downconverts 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 -5 to +25 dBmV while providing optimum wireless transmit power. The hub wireless transmitter power, determined by the **Downstream Path Optimization** setting, can be set for on of three modes: High (+19 dBm), Medium (+13 dBm), or Low (+3 dBm).

Note: The “High” power setting is for use with the AX1255-SM-90 and AX1255-VM-90 Network Hubs. Use of the “High” power setting with the AX1255-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 operation that 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

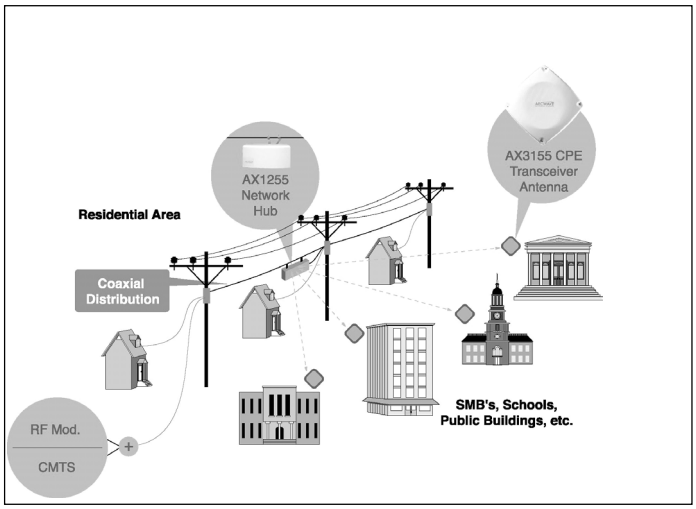


Figure 2-3: Wireless Drop

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 your plant:

- The AX1255-SM-90 hub includes a 90° beamwidth antenna with a range up to 1 mile at 64 QAM and ¼ mile at 256 QAM;
- The AX1255-SM-25 includes a 20° beamwidth antenna with a range of 2 miles at 64 QAM and 1 mile at 256 QAM.

Wireless Feeder

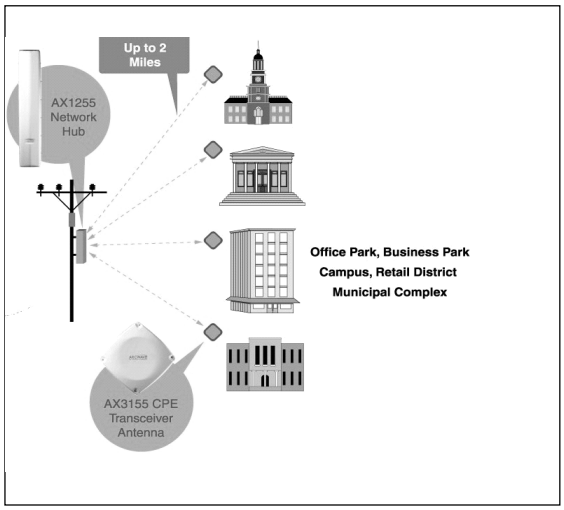


Figure 2-4: Wireless Feeder

ARCXtend can be deployed as a wireless feeder solution connecting hundreds of customers. An AX1255-VM vertical mount hub mounts on a utility pole, tower, or building providing the extended range coverage required for retail districts, office parks, or campuses.

- The AX1255-VM-90 vertical mount hub includes a 90° beamwidth antenna with a range of 2 mile at 64 QAM and ½ mile at 256 QAM.

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 MSOs 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:

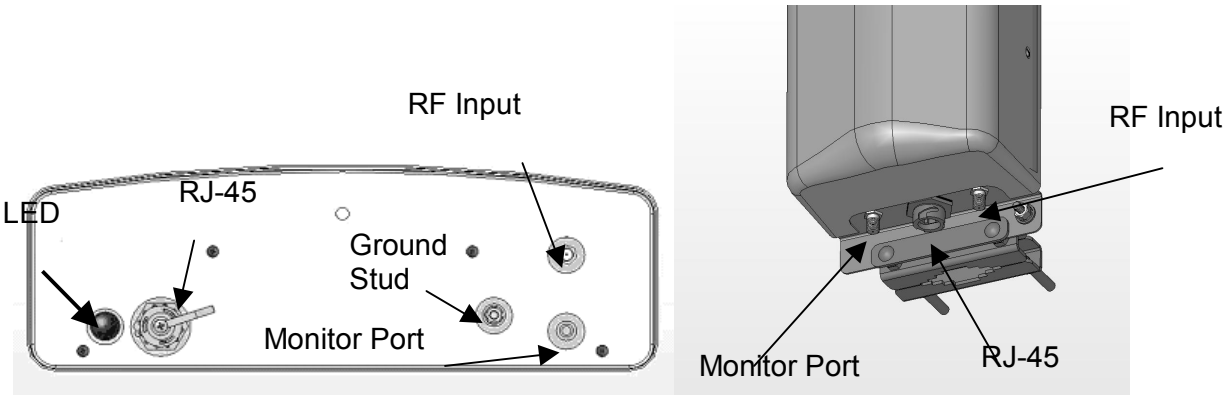


Figure 2-5 AX1255-SM (on left) and AX1255-VM Connectors (on right)

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 downstream 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. (AX1255-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 beamwidth ("90", for 90-Degree Horizontal Beamwidth and "25", for 20-Degree Horizontal Beamwidth).

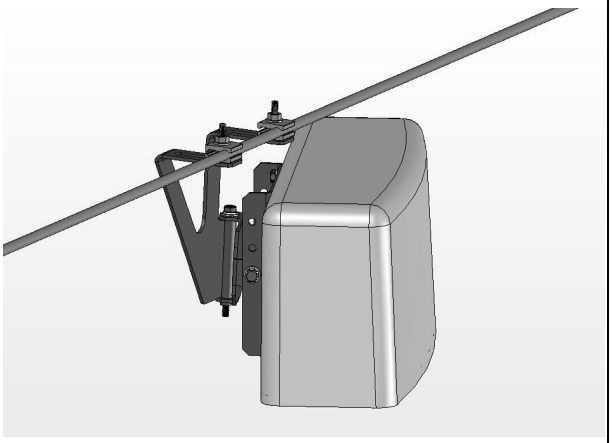
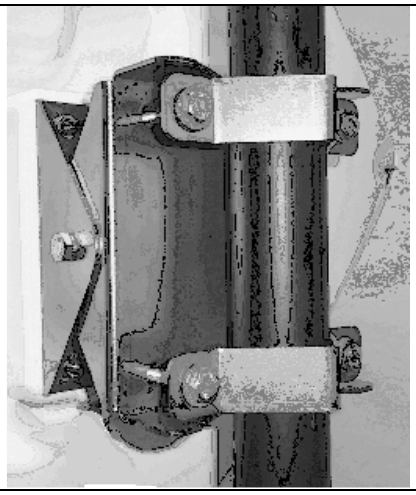
All Hubs support both 60 to 90 VAC powering over coax and 24 VDC powering over Ethernet (POE).

The standard network hub configurations are:

Model number	Downstream Frequency Band	Upstream Frequency Band	Mounting Orientation	Transmit Antenna Beamwidth	Downstream Range		
					64 QAM	256 QAM	
Bidirectional Systems							
AX1255-SM-90	5725 MHz – 5850 MHz	5250 MHz - 5350 MHz	Horizontal	90 Degrees	1 Mile	¼ Mile	
AX1255-SM-25	5725 MHz – 5850 MHz	5250 MHz - 5350 MHz	Horizontal	20 Degrees	2 Miles	1 Mile	
AX1255-VM-90	5725 MHz – 5850 MHz	5250 MHz - 5350 MHz	Vertical	90 Degrees	2 Miles	½ Mile	
Upstream Only, No remote monitoring. If remote monitoring is desired use a standard AX1255-VM-90.					QPSK	16 QAM	64 QAM
AX1205-VM-90	5725 MHz – 5850 MHz	5250 MHz - 5350 MHz	Vertical	90 Degrees	8 Miles	4 Miles	2 Miles

Table 2-2: Hub Configurations

Hub Mounting Kits

Works with	Model	Description	Image
AX1255-SM	Standard	ARCXtend Strand Mount Kit Used to mount an AX1255-SM to a standard strand cable Includes integrated mounting bracket providing 360° vertical and +/- 30° horizontal adjustment for rapid and flexible antenna alignment.	
	AX1255-SMA	ARCXtend Strand Mount Adaptor Kit, Network Hub Used to mount an AX1255-SM in the horizontal position on a 1-1/4 to 2-3/8 O.D. pipe mount	

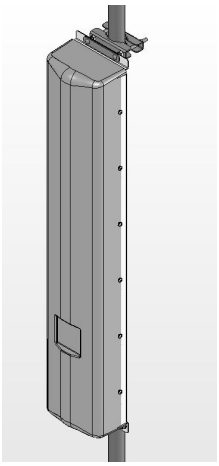
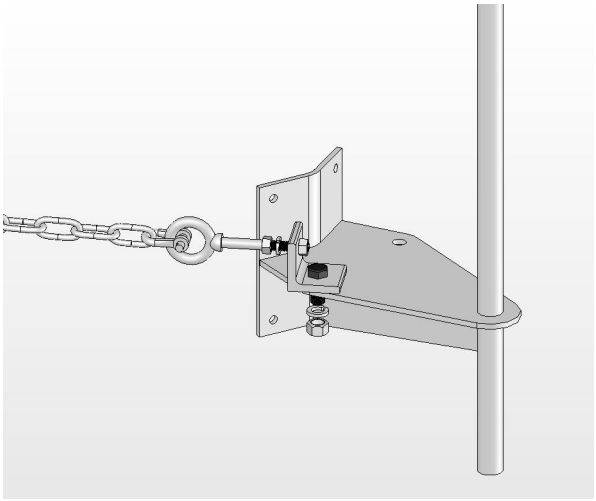
AX1255-VM	AX1255-MMK	ARCXtend Mast Mount Kit, Network Hub Included with all AX1255-VM Hubs Enables the Hub to mount to a mounting pipe with an outside diameter from 1 1/4“ to 2 3/8”	
	AX1255-PMK	ARCXtend Pole Mount Kit, Network Hub Includes the AX1255-MMK Enables the Hub to be mounted to a standard diameter 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, as show in Figure 8 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.

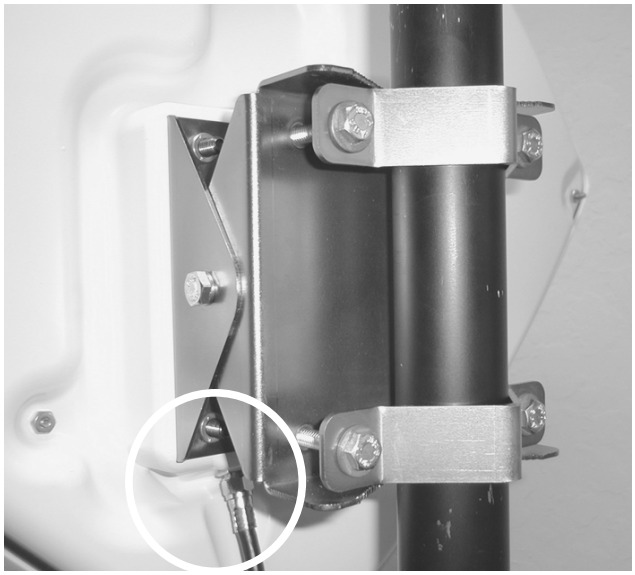


Figure 2-6: CPE RF Connector

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 beamwidth ("90", for 90-Degree Horizontal Beamwidth).

All CPEs support 12 VDC powering over Coax.

The standard CPE models are:

Model number	Downstream Frequency Band	Upstream Frequency Band	Mounting Orientation	Transmit Antenna Beamwidth	Upstream Range		
					QPSK	16 QAM	64 QAM
AX3155-VM-90	5725 MHz – 5850 MHz	5250 MHz – 5350 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

- AX3155-PS-12: 120 VAC 60 Hz/12 VDC adaptor and DC Inserter

Downstream Signal Attenuators

- AX3155-ECF-10: 10 dB Downstream Attenuator for attenuating the DS signal level without affecting the US signal level
- AX3155-ECF-20: 20 dB Downstream Attenuator for attenuating the DS signal level without affecting the US signal level.

ARCSmart™ 2.0 Intelligent Network Management

Arcwave's ARCSmart intelligent network management combines an embedded DOCSIS 2.0 compliant cable modem, SNMP-compliant Arcwave Enterprise MIB (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 prescale 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 Arcwave website.

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 or 19 dBm
- Medium or 13 dBm
- Low or 3 dBm

Note: The "High" power setting is for use with the AX1255-SM-90 and AX1255-VM-90 Network Hubs. Use of the "High" power setting with the AX1255-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 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.

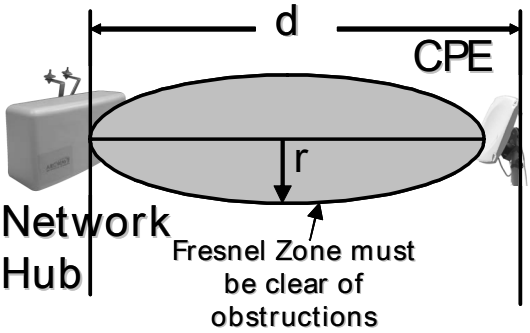
PRE-DEPLOYMENT PLANNING

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 three models of Hubs are given in Tables 3-1, 3-2, and 3-3.

Modulation	Range	Arc	Area
Downstream Wireless Link			
64 QAM (DS)	1 mile	1.6 miles	0.8 sq-miles
256 QAM (DS)	0.25 miles	0.4 miles	0.05 sq-miles
Upstream Wireless Link			

QPSK (US)	3 miles	4.2 miles	7.0 sq-miles
16 QAM (US)	2 miles	3.1 miles	3.1 sq-miles
64 QAM (US)	1 mile	1.6 miles	0.8 sq-miles

Table 3-1: AX1255-SM-90 Strand Mounted Network Hub (18 ft off the ground)

Modulation	Range	Arc	Area
Downstream Wireless Link			
64 QAM (DS)	2 miles	3.1 miles	3.1 sq-miles
256 QAM (DS)	1 mile	1.6 miles	0.8 sq-miles
Upstream Wireless Link			
QPSK (US)	6 miles	9.4 miles	28.0 sq-miles
16 QAM (US)	3 miles	4.7 miles	7.0 sq-miles
64 QAM (US)	2 miles	3.1 miles	3.1 sq-miles

Table 3-2: AX1255-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	3.1 sq-miles
256 QAM (DS)	0.5 miles	0.8 miles	0.20 sq-miles
Upstream Wireless Link			
QPSK (US)	6 miles	9.4 miles	28.0 sq-miles
16 QAM (US)	3 miles	4.7 miles	7.0 sq-miles
64 QAM (US)	2 mile	3.1 miles	3.1 sq-miles

Table 3-3: AX1255-VM-90 Vertical Mounted Network Hub (100 ft off the ground)

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. Try first to find locations on your plant that fall within the range of the AX1255-SM-90 and the AX1255-SM-25 and then the AX1255-VM-90.

The AX1255-SM-90 provides maximum coverage area at the expense of limited range, whereas the AX1255-SM-25 provides maximum range at the expense of limited coverage area. The AX1255-

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

VM-90 provides maximum coverage and maximum range but requires access to a building or tower for mounting. Locations on building or towers are availably but generally involve a lease agreement with the owner and the site must be within a thousand feet of the cable plant.

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 Interference

ARCXtend maps the upstream DOCSIS channel to a high frequency and a low frequency pair in the 5.250 to 5.350 GHz band. This mapping is fixed and based solely on the frequency of the upstream DOCSIS channel. Determine the corresponding wireless channels the upstream frequency used in your cable plant. Check for interference at both frequencies and note which of these channels are free of interference, as it will be used for the deployment. If you can't find free spectrum for the downstream and upstream signals then you will need to find another 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 monitoring, 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 are that it 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.

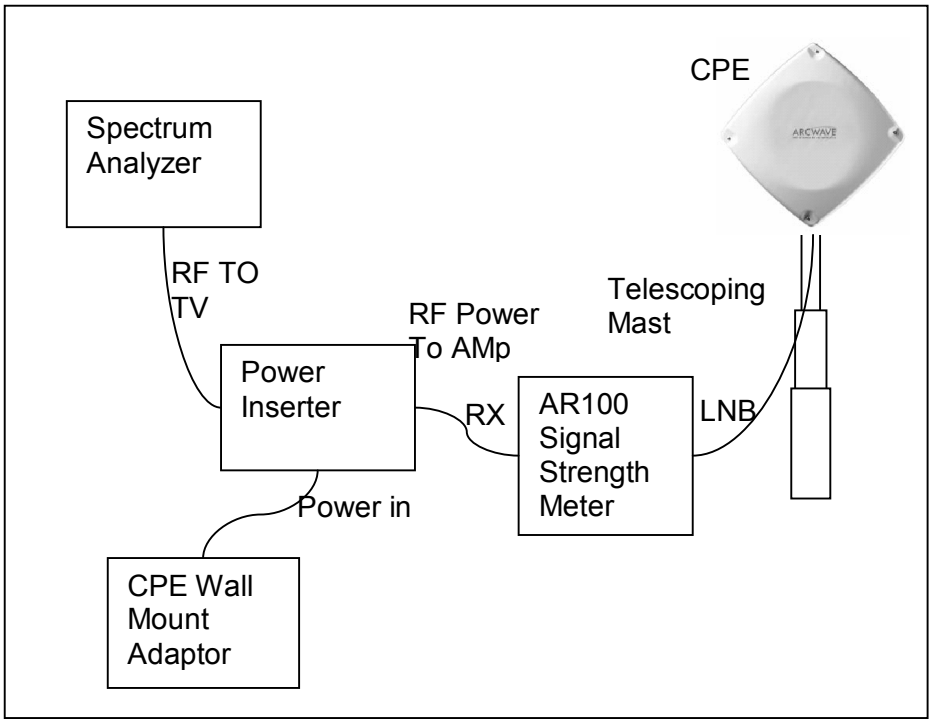


Figure 3-2: CPE Site Survey Setup

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 Channel	CPE Downstream RF Channel	Hub Downstream Wireless Carrier Channel	CPE Downstream RF Channel	Hub Downstream Wireless Carrier Channel	CPE Downstream RF Channel
5729 MHz	429 MHz	5771 MHz	471 MHz	5813 MHz	513 MHz
5735	435	5777	477	5819 *	519
5741	441	5783	483	5825 *	525
5747	447	5789	489	5831 *	531
5753	453	5795	495	5837 *	537
5759	459	5801	501	5843 *	543
5765	465	5807	507		

* Pending FCC approval.

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.

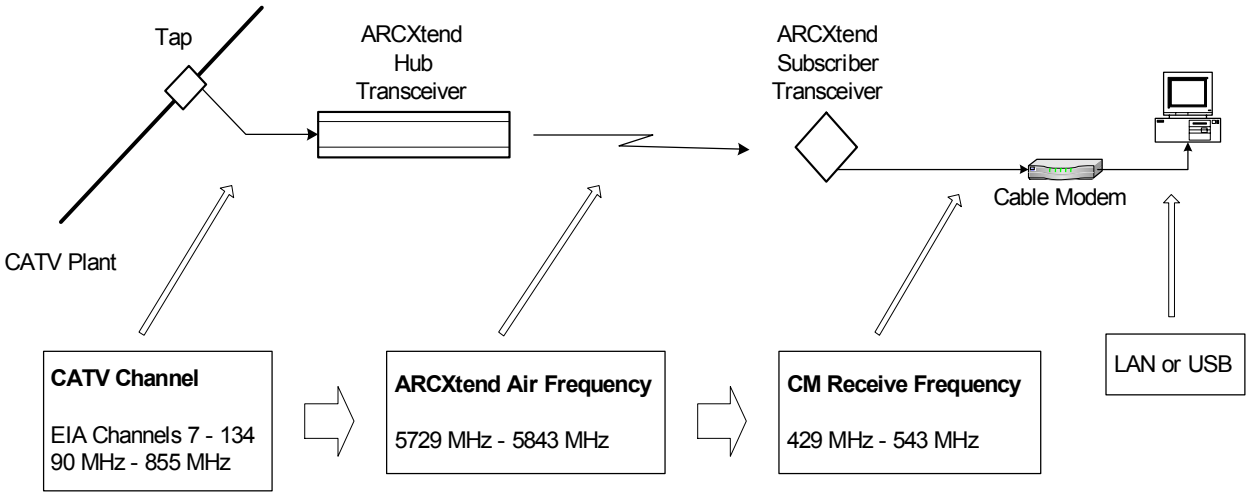


Figure 3-3: ARCXtend Downstream Block Diagram

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-3 in Appendix A provides a list of these channels and their corresponding center frequencies.

The downstream output of the ARCXtend Hub is the over-the-air frequency in the range of 5729 MHz through 5843 MHz. Any frequency in this range can be chosen from Table 3-4, which determines the corresponding cable modem receive frequency. Note from the table that the cable modem downstream receive frequency is always [air frequency – 5300 MHz]. The ARCXtend standard downstream air frequencies were chosen to ensure that the corresponding cable modem downstream receive frequencies are centered on standard EIA CATV channels to enable the fastest possible cable modem downstream scan.

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 air frequency only. 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 4-2. 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.

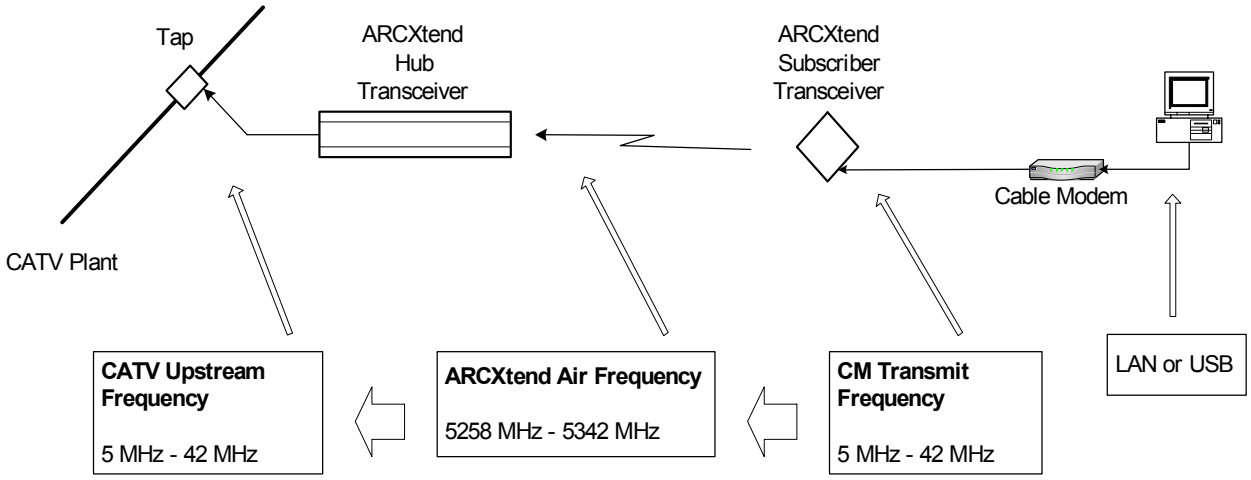


Figure 3-4: ARCXtend Upstream Block Diagram

Upstream Block Diagram

The cable modem (CM) is commanded by the downstream signal to transmit at a specific upstream frequency between 5 MHz and 42 MHz. Note that any upstream frequency may be selected.

Refer to Figure 3-4 from right to left. The ARCXtend Subscriber Transceiver (CPE) up converts the CM upstream signal to the 5300 MHz band and transmits two copies of the signal: 5300 MHz-[CM transmit frequency] and 5300 MHz+[CM transmit frequency].

For example, if the CM upstream transmits frequency is 22.5 MHz; the ARCXtend CPE will simultaneously transmit the signal on two air frequencies: 5277.5 MHz and 5322.5 MHz.

In summary, the CM upstream transmit frequency determines the two upstream air frequencies transmitted by the ARCXtend CPE. The ARCXtend Hub selects either the high or low air frequency and passes the user data upstream to the CATV plant at the original CM transmit frequency.

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 at levels within approximately 25 dB of each other, the combined signal on the upstream will be unusable.

The solution is to utilize different upstream CM transmit frequencies, and therefore different upstream air frequencies, in the different Hubs. This means that each CM transmit frequency will be passed upstream into the CATV plant. Note that this will require the CATV plant and CMTS to accommodate these separate upstream channels. Recall that DOCSIS supports multiple upstream channels working with a single downstream. All CMs served by any given Hub must be provisioned for the same upstream frequency.

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 be prior to installation to confirm with 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 powering power. The internal power supply provides a regulated 24 VDC output

over an ac input between 45 Vrms and 125 Vrms 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.

Connections are made using standard pin-type connectors with a nominal center-conductor diameter of 0.067 inches. The minimum length of the center-conductor pin is 1.5 inches and the maximum length is 1.65 inches. Longer pins can extend past the center-conductor seizure mechanism and degrade the match. Extremely long pins can result in a short circuit.

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. DC power should be applied to the CAT5 cable using the “Injector” provided by Arcwave.

Inset RJ-45 pin configuration

RF Signal Power Level and Quality

The Hub requires a downstream path RF power level at the input RF port of between -5 dBmV and +25 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 12 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 100 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/ Serial & Ethernet Ports	Multiple	Hub monitoring and configuration

Material	Source	Use
ARCXtend Network Hub	Arcwave AX1255-SM-25, AX1255-SM-90, AX1255-VM-90	Wirless interface to cable network on plant side
ARCXtend CPE	Arcwave AX3155-VM-12	Wirless interface to cable network on customer side
ARCXtend CPE Power Adaptor and DC Inserter	Arcwave AX3155-PS-12	Powering CPE
ARCXtend Network Hub Management Kit, M/N	Arcwave AX1255-IFK-232	Hub Interface Cable Kit
10dB and 20dB low pass attenuators	Arcwave AX3155-ECF-10 AX3155-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 range is between 50 Vac and 110 Vac nominal.
2. Verify that the input the downstream RF signal level is between -5 dBmV and +25 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.

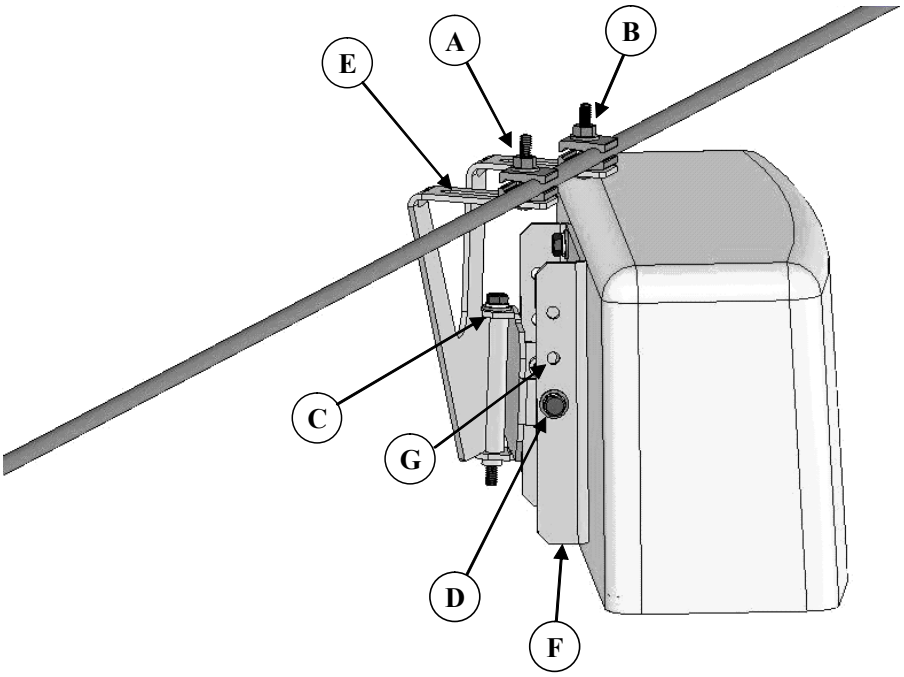


Figure 4-1: Hub Installation Diagram

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 show 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.

(Optional) Secure the Hub to the Mast

Install the Hub per the steps provided below using a 7/16” combination or socket wrench.

1. Slide the mast mount brackets over the mounting pipe. Snug the bracket bolts.
2. Rotate the Hub towards the customer sites to be covered.
3. Adjust the down tilt of the Hub by increasing the gap between the Hub and the bracket at the top and decreasing the gap between the Hub and the bracket at the bottom as show in Figure 4-2.

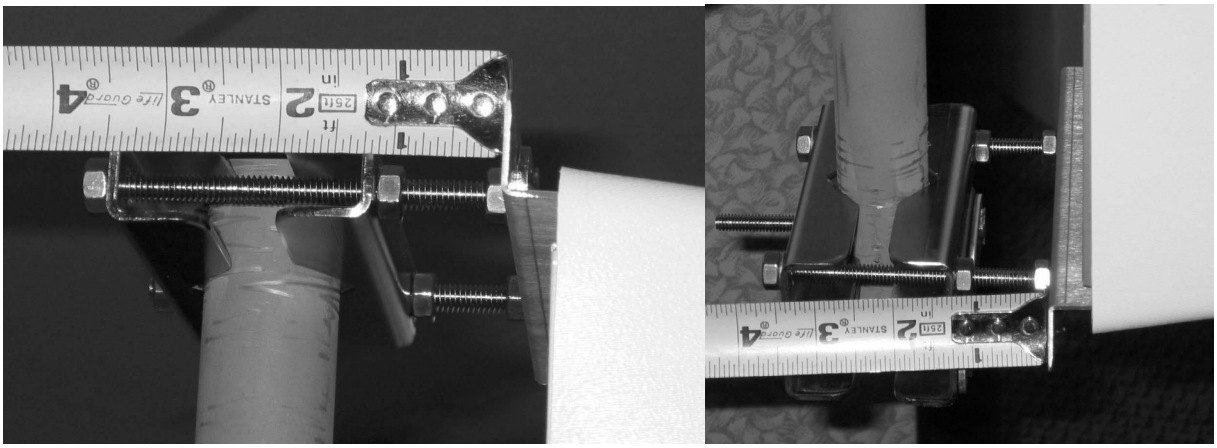


Figure 4-2: Mast Mount Kit Bracket Offset

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 vai an internet browser with the IP address set to 192.168.100.1.

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 Information 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 Real Time Monitor Information table on 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 AX1255-SM-90 and AX1255-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 at any link and 64 QAM modulation with links less than or equal to ¼ mile.
    c. Low for use with all model Hubs at links below 500 feet.

Note: The “High” power setting is for use with the AX1255-SM-90 and AX1255-VM-90 Network Hubs. Use of the “High” power setting with the AX1255-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 EMC is operational, the **Upstream Attenuation** level is set automatically based on the upstream transmit power level of the ECM. If the EMC 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.

a. For a **Select Downstream Power** setting of **High** or **Medium** verify that the **Downstream Transmit Power** setting indicates 10 or greater .
b. For a **Select Downstream Power** setting of **Low** verify that the **Downstream Transmit Power** setting indicates **Below 10**.

Set the Hub Management Mode

☞Referring to the Real Time Monitor Information table on the Arcwave MIB page of the user interface:

1. Enter Title, if desired, otherwise it defaults to the MAC address of the ECM.
2. Set the Alarm Destination IP address, if desired.
3. 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 using the embedded 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.

CPE installation

☞Install the CPE mounting hardware (not supplied by Arcwave) 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 4-3, 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.

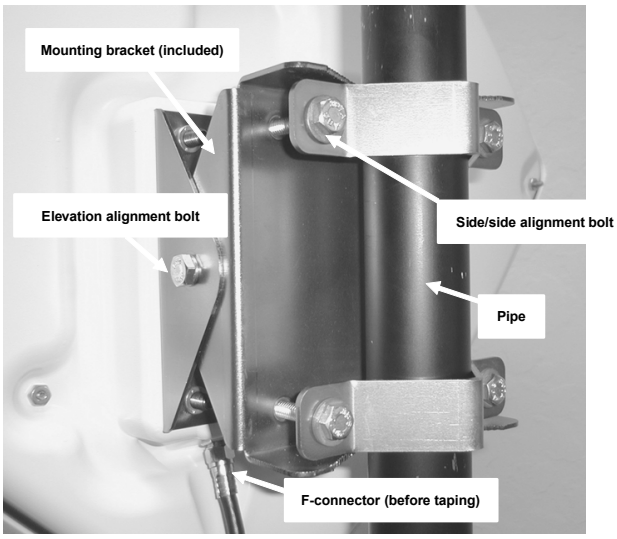


Figure 4-3: CPE Mounting Diagram

Install the Coaxial Cable and Ground Connection

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

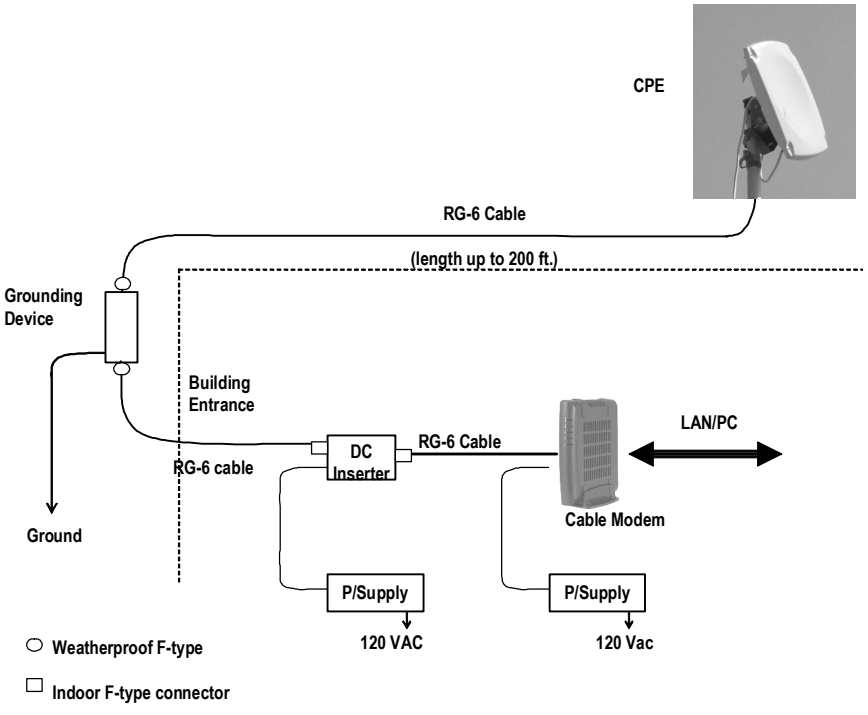


Figure 4-4: CPE Wiring Diagram

☞ 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.

☞ Mount a CATV system standard grounding device in Figure 5-5 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.

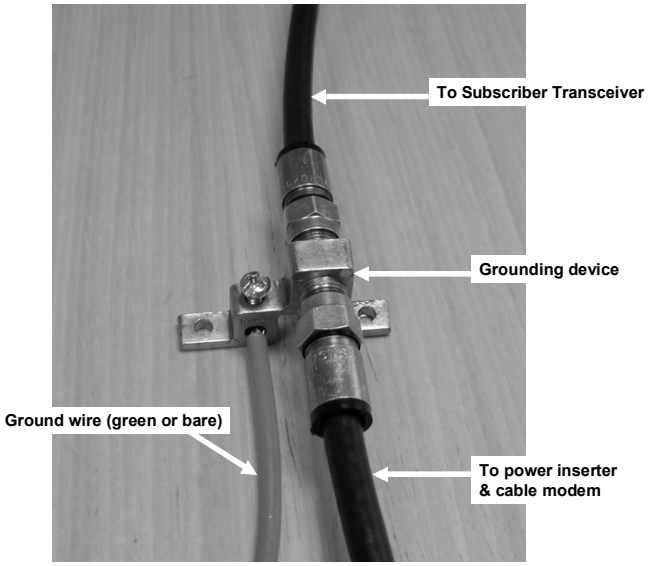


Figure 4-5: Grounding device at subscriber premises

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

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

☞ 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 “to antenna” F female connector of the power inserter.

Install the power adaptor and DC inserter

☞ Install the DC inserter as show in Figure 4-6. Connect the power adaptor to the DC inserter as show in Figure 4-4 and figure 4-6. Plug the power adaptor into a surge protected AC power receptacle. Note the AC Power Pack must be within 300 feet of the CPE.

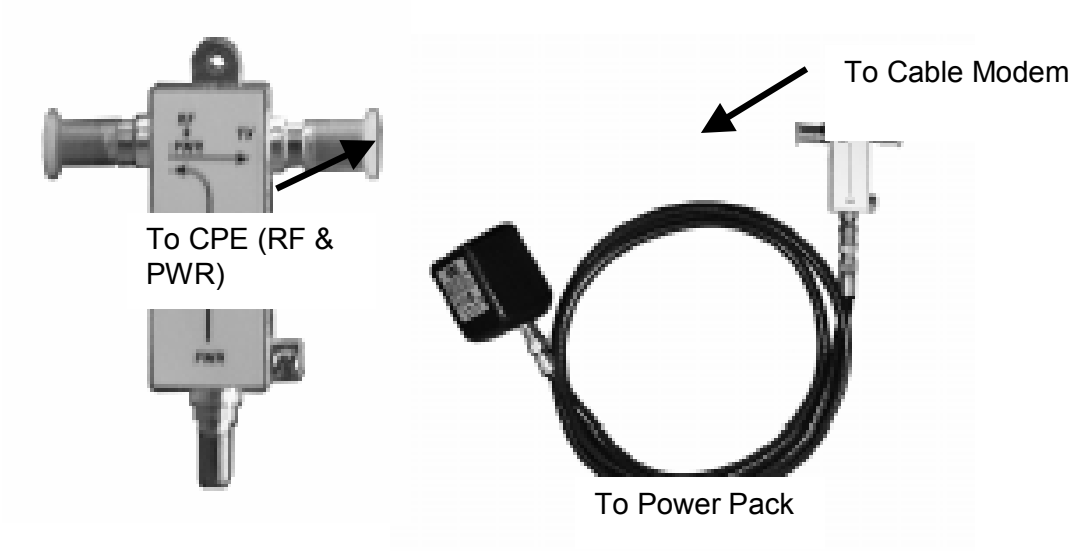


Figure 4-6: Power Inserter and AC/DC adaptor

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 4-7) or equivalent signal strength meter .

Figure 4-7: 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 (AX3155-ECF-10) or 20 dB (AX3155-ECF-20) low pass attenuators between the power inserter and the cable	Select Downstream Power setting is correct. Reduce the cable and RF hardware loss between CPE and cable modem or add bi-	Verify integrity of in-building cabling and power. Make sure CPE Power Adaptor and DC inserter are installed properly.

modem. If more than 30 dB of attenuation is required and the **Select Downstream Power** setting is **High,** change the setting to **Medium.**	directional amplification. Redo the CPE alignment process Verify the wireless range and LOS path between Hub and CPE are within specified limits.	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.

Cable Modem Installation

☞Connect the cable modem to the modem side of the DC power inserter as shown in 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 to cable modem	DS received power level is too low
If the DS received power level is too high install one or more 10 dB (AX3155-ECF-10) or 20 dB (AX3155-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 4-2: DS received power level troubleshooting

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 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.	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.

Table 4-3: 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 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 4-4: 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 4-5: 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. This can be done by looking at the BER of the cable modem in the hub. 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 4-6: 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, 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.

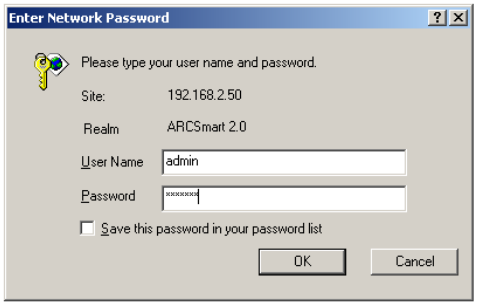


Figure 5-1: Hub login screen

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

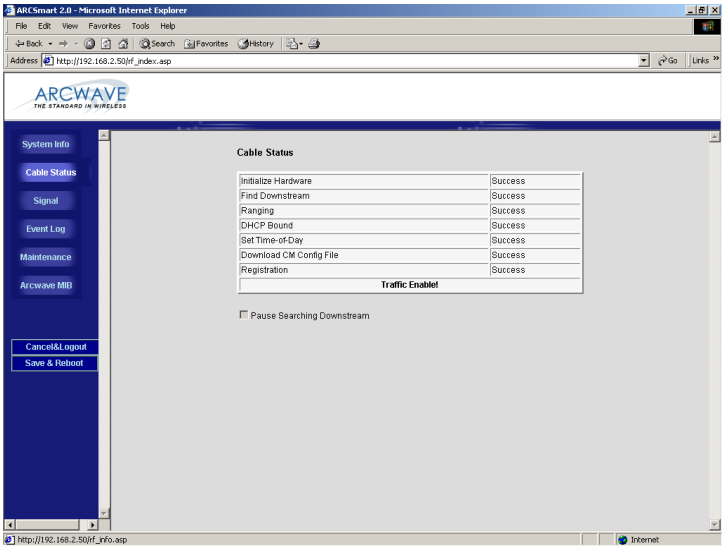


Figure 5-2: Cable Status page

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. And it will try the tuning the upstream power to make it has equivalent power that CMTS requests to be.
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

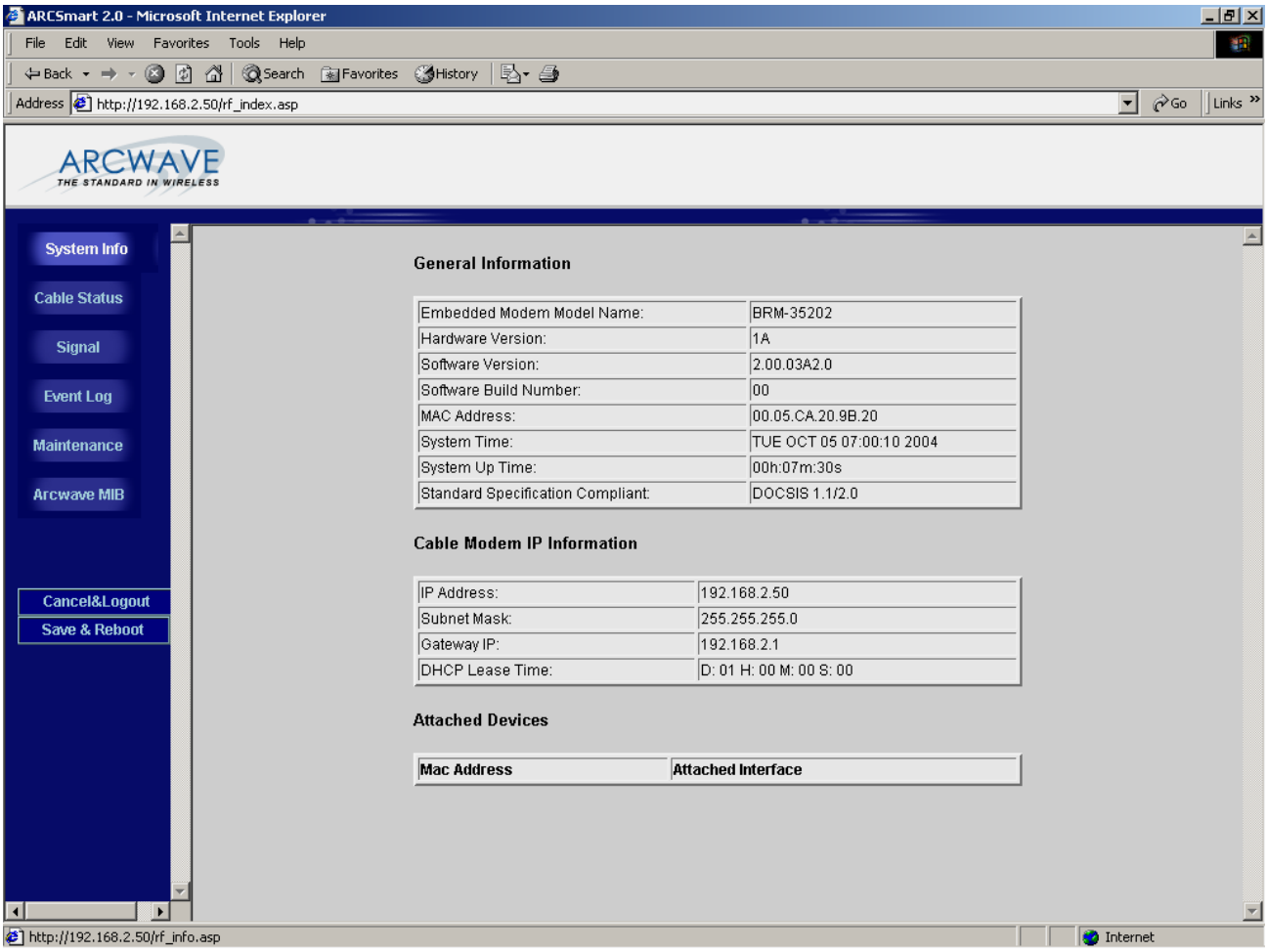


Figure 5-3: System Info page

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

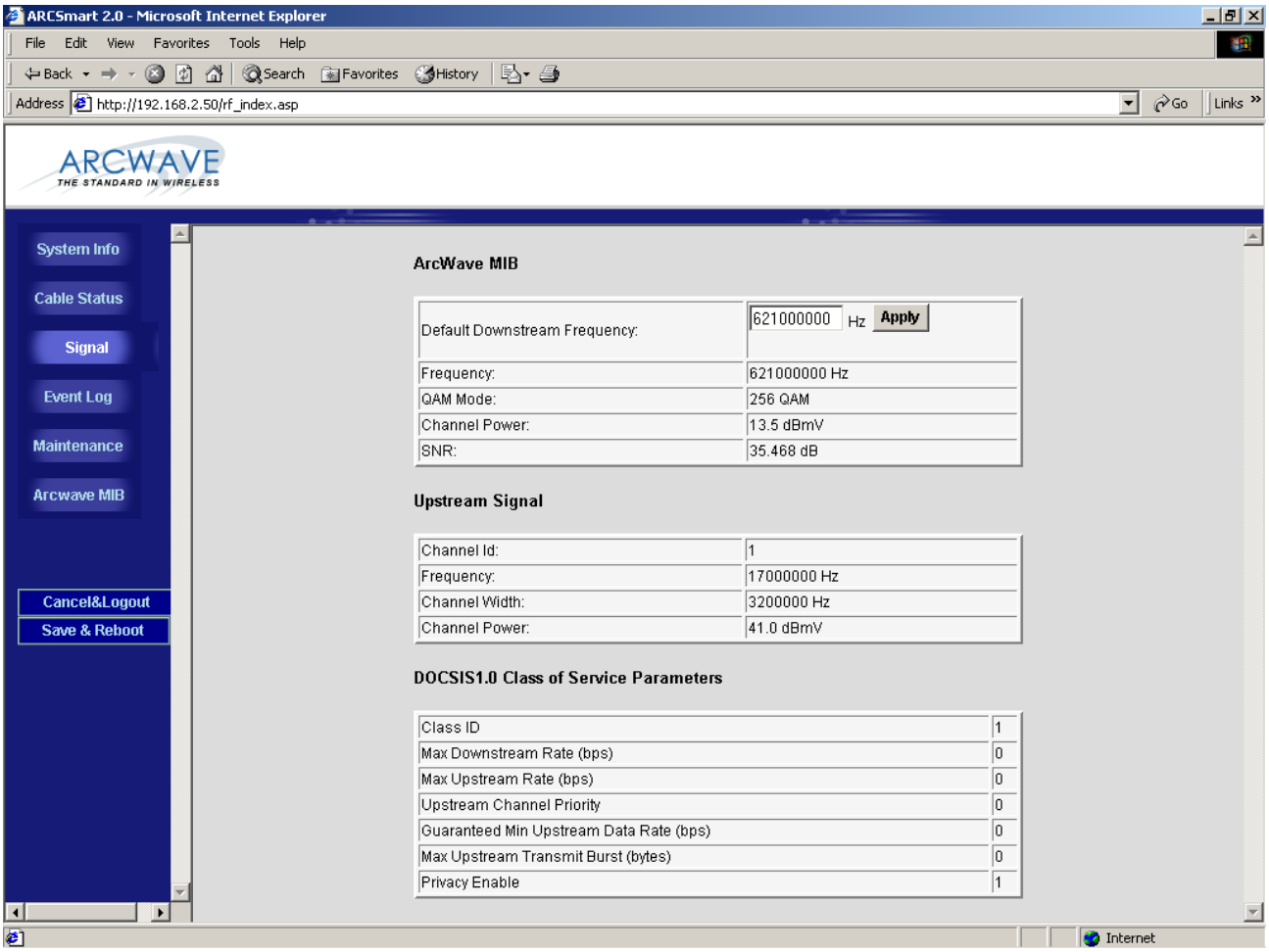


Figure 5-4: Signal Page

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

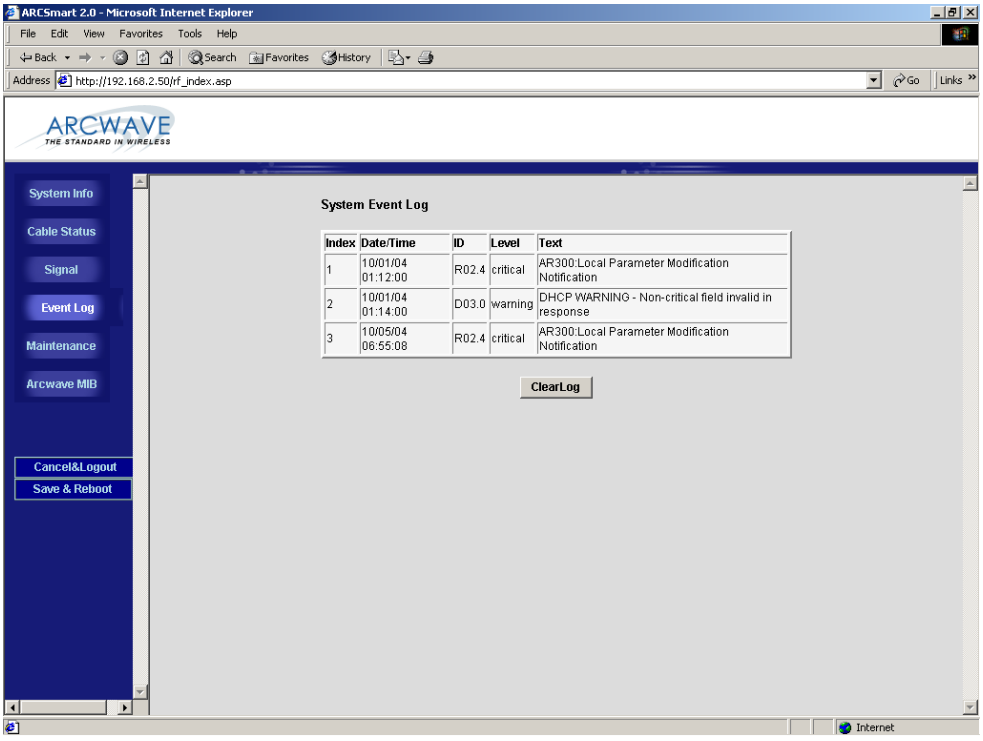


Figure 5-5: System Event Log page

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

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.
AR300 Downstream (Transmitter) Over Temperature	The Unit is operating above Max. operating temperature	Major	This alarm gets displayed	The Unit is operating above Max. operating temperature/ Check operating temperature, clear alarm & switch the unit off if condition does not go away.	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	The	Critical	Modems on	The	Lost of traffic,

Table 5-1: ARCSmart Event Messages

Maintenance

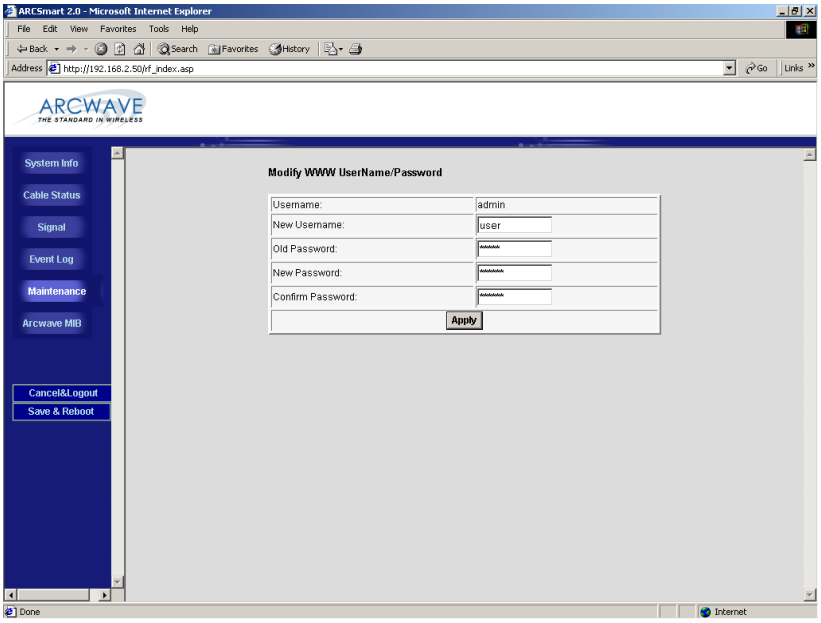


Figure 5-6: Maintenance Page

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 page

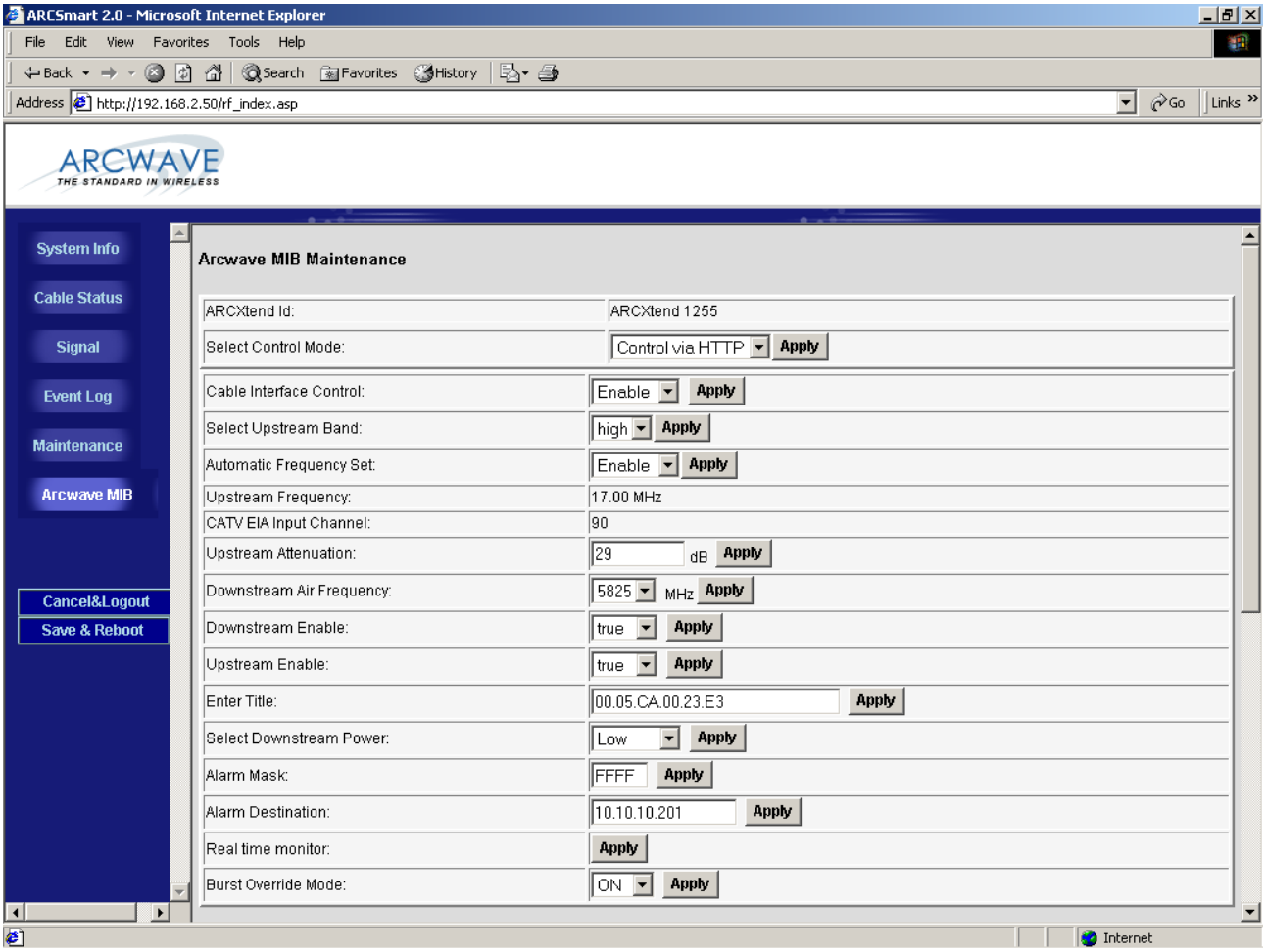


Figure 5-6: Arcwave MIB page

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, AX1255 or AX1455. This parameter is used internally by ARCSmart to customize the user interface based on the Hub type.
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.
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 "Off" setting will prevent the ECM from continually scanning for a downstream channel, when none is present. The default setting is "On"
Select Upstream Band	Chose which of the two copies of the upstream wireless carrier being transmitted by the CPE is to be received by the Hub and passed to the cable network. This parameter is used to avoid potential interference on the upstream channel. If High is chosen, then the Hub will receive the upstream wireless carrier at 5300 MHz plus the frequency of the upstream channel If Low is chosen, then the Hub will receive the upstream wireless carrier at 5300 MHz minus the frequency of the upstream channel. For example, if the upstream frequency is 32.0 MHz, the wireless signal will be transmitted at 5332 MHz (High) and 5268 MHz (Low). As show in Table 5-2, certain combinations of downstream wireless carrier frequencies and upstream channels require a specific High or Low setting for optimal performance. For all other downstream wireless carrier frequencies, the default setting is High.
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".
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 any other value in the valid range from 0 to 64 is entered, that the attenuation is set to that value. This parameter is used to increases or decreases 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 AX1255 model Hubs are: 5729, 5735, 5741, 5747, 5759, 5765, 5771, 5777, 5783, 5789, 5795, 5807, 5813, 5819, 5825, 5831, 5837, and 5843 (in MHz). The downstream channel frequency out of the CPE is the Downstream Air Frequency minus 5300 MHz. The default setting is 5759.
Downstream Enable	Chose “TRUE” to turn on the downstream wireless transmitter and “FALSE” to turn it off. The default setting is “TRUE”.
Upstream Enable	Chose “TRUE” to turn on the upstream wireless receiver and “FALSE” to turn it off. The default setting is “TRUE”.
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.
Select Downstream Power	Chose the downstream wireless transmitter power setting. If “High” is selected, the transmit power is set to 19 dBm. (For use with AX1255-VM-90 and AX1255-SM-90 Hubs only.) If “Medium” is selected, the transmit power is set to 13 dBm. If “Test” is selected, the transmit power is set to 3 dBm.
Alarm Mask	Enter the hex value of the events that are to be masked. All 0’s masks all alarms, all F’s lets all alarms through, individual alarms are as follows: Definition of mmmm failure code (Logical OR of the bits)

	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
Alarm Destination	Enter the IP address where SNMP traps are to be sent by the Hub.
Clear Alarms	Click on the “Apply” button to clear all alarms. (presented in the “Event Logs” page)
Real time monitor	Click on the “Apply” button to refresh the Real Time Monitor display.
Burst Override Mode	Chose “On” to disable PureBurst and “Off” to enable 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.

Firmware Download Information

ARCXtend Id	Displays the Hub type, AX1255 or AX1455. This parameter is used internally by ARCSmart to customize the user interface based on the Hub type.
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 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 AX300 module hardware revision number.
DCE Lock:	Displays the status of the Hub cable network interface in the downstream direction. It will display “TRUE” if the Hub is

	receiving a downstream channel and “FALSE” if it is not.
Downstream 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.
Downstream Transmit Power:	Displays the power level of the Hub wireless transmitter into the antenna.
Upstream 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 AX300 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.
Transmitter Temperature:	Displays the temperature in degrees Celsius at the surface of the Hub wireless transmitter module.

DS Wireless Carrier Frequency (MHz)	Upstream Channel Center Frequencies (MHz)	Default High / Low Setting
5729 and 5735	29.5 through 30.4	This combination is not allowed and the DS will automatically be changed to 5741.
5729 and 5735	30.5 through 42.4	High
5741	13.5 through 26.4	High
5747	13.5 through 26.4	High
5753	13.5 through 26.4	High
5759	5.5 through 10.4	High
5765	5.5 through 10.4	High
5771	5.5 through 18.4	Low
5777	5.5 through 18.4	Low
5783	5.5 through 18.4	Low
5789	21.5 through 34.4	Low
5795	21.5 through 34.4	Low
5801	21.5 through 34.4	Low
5807	37.5 through 43.4	Low
5813	37.5 through 43.4	Low
5819		High
5825		High
5831		High
5837		High
5843		High
5741 through 5843	29.5 through 30.4	Low
5729 through 5843	If not otherwise shown above	High

Table 5-2: Default Upstream Band Setting

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

AX1255 Network Hub

Transceiver	
Wireless Channels	Downstream: 20, 6.0 MHz Channels Upstream: 14, 3.2 MHz Channels 7, 6.4 MHz Channels
Wireless Frequency Range	(TX) 5.725 to 5.850 GHz; (RX) 5.250 to 5.350 GHz
Maximum Transmit Output Power	High: +19 dBm (Note: The "High" power setting is for use with the AX1255-SM-90 and AX1255-VM-90 Network Hubs. Use of the "High" power setting with the AX1255-SM-25 cancels the FCC certification and voids the user's authority to operate the unit in the 5.8 GHz band.) Medium: +13 dBm Low: + 3 dBm
RF Frequency Range	90 to 860 MHz (Downstream); 5 to 42 MHz (Upstream)
Downstream Modulation Supported	64 QAM, and 256 QAM
Upstream Modulation Supported	QPSK, 16 QAM, and 64 QAM
Downstream Input Signal Level into the Hub	-5 to +25 dBmV
Upstream Output Signal Level out of the Hub	+35 dBmV Typical
Upstream Receiver Noise Figure	3.5 dB Typical
Adjacent Channel Rejection	Greater than 40 dB
Antenna	

	AX1255-VM-90	AX1255-SM-90	AX1255-SM-25
Horizontal Beamwidth (–3 dB)	90°	90°	20°
Vertical Beamwidth (-3 dB)	6°	20°	20°
Transmit Gain	13 dBi	10 dBi	20 dBi
Receive Gain	16 dBi	10 dBi	16 dBi
EIRP	31.5 dBm	28.5 dBm	32 dBm

Network Management	
MIB	SNMP MIB (Alarms, Parameters, Metrics)
Remote	SNMP or HTTP-bases User Interface
Local	HTTP-bases User Interface
Mechanical, System, and Regulatory	
Services Supported	DOCSIS, Digital and Analog Video, CBR Voice, T1/E1
Input Power	60 or 90 Vac nominal; 45 to 125 Vac actual; or +24 Vdc nominal
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	AX1255-VM-90	AX1255-SM-90/25
	41” x 7” x 5”, 14 lbs.	17” x 7.5” x 5.6”, 6 lbs.

Table 7-1: AX1255 Specifications

AX3155 Customer Premise Antenna / Transceiver (CPE)

Transceiver	
Wireless Channels	Downstream: 20, 6.0 MHz Channels
	Upstream: 14, 3.2 MHz Channels
Wireless Frequency Range	(TX) 5.250 to 5.350 GHz; (RX) 5.725 to 5.850 GHz
Maximum Transmit Output Power	+30 dBm EIRP
Receiver Noise Figure	Less than 3.5 dB typical
DOCSIS Frequency Range	425 to 550 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	
Horizontal Beamwidth (–3 dB)	10°
Vertical Beamwidth (-3 dB)	20°
Transmit Gain	14 dBi
Receive Gain	22 dBi
Mechanical, System, and Regulatory	
Input Power	120 Vac Power Pack
Operating Power	18 Vdc Power of Coax
Maximum Distance from CPE to	300 feet

Power Pack	
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: AX3155 Specifications

Environment Specifications

The environmental specifications for the ARCXtend solution including the AX1255, AX3155 and associated electrical and mechanical subassemblies are given in Table 9-3 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

CUSTOMER SUPPORT

Following is a description of the services we make available to our customers and channel partners.

For current service pricing please refer to your current price list.

Service Policy

Our support organization provides pre-sale, installation and post-sale support to service providers who have purchased systems directly from us. We offer 24-hour telephone support seven days a week. The services listed in this guide are in addition to the standard warranty offered with all Arcwave provide products.

Services provided during standard warranty period are:

- Free of charge hardware repairs and software/firmware fixes during the warranty period.
- Free of charge access to 24/7 technical support for 90 days

Services

Arcwave offers its customers and partners a complete set of support services on a demand basis or under a regular or negotiated service agreement.

Technical Services

- Technical assistance
- Telephone and E-Mail
- RMA (Return Material Authorization) Process
- Documentation
- Installation and Planning Manuals
- Application Notes
- Onsite Support
- Emergency Onsite Support

Software/Firmware Services

- Updates
- Upgrades

Hardware Services

- Warranty repair and return
- Out-of-Warranty repair and return

Training Services

- Technical Training
- Sales Training

Standard Service Agreements

Our standard service agreement provides for:

- Free of charge access to 24/7 technical support
- Free of charge software/firmware upgrades
- Training at 15% discount
- On-Site Field Support at a 10% discount
- Emergency On-Site Field Support at a 10% discount
- Spares at 10% discount
- Custom service and extended warranty agreements are available upon request.

Technical Services

Technical Assistance

- 24/7 Customer Service Line: (408) 748-7570 or (800) 863-8225
- Customer Service E-Mail: techsupport@arcwaveinc.com

Return of Material Authorization (RMA) Initiation and Tracking

The RMA process is initiated by contacting Arcwave technical support via telephone or e-mail. Following receipt and review of the RMA request and if the return is authorized, Arcwave will assign an RMA number. Only after receipt of this number is the customer authorized to ship the product back to Arcwave. The RMA number is subsequently used to track the status of the return

Onsite Support

Arcwave on-site support service is provided per customer request. The appropriate technical support engineer will be dispatched to the customer site after agreed upon objectives have been established between the customer and Arcwave. It is the customer's duty to make necessary preparations for the visit, provide access to the relevant sites, and escort Arcwave personnel during their visit. The customer will also provide security arrangements whenever required. Arcwave will work with the customer to schedule onsite support in a timely fashion. At the end of the visit, Arcwave will provide a report summarizing the problem(s) found, corrective action(s) taken, and any recommendations to prevent the problem(s) from reoccurring in the future.

Emergency Onsite Support

If an emergency condition, such as a network outage, arises Arcwave will make every effort to dispatch the appropriate technical support engineer as soon as reasonably possible and upon terms agreed to with the customers. This normally means the customer has agreed to pay for expedited travel and lodging expenses as well as normal emergency onsite support rates.

Software / Firmware Services

Updates

Arcwave will provide periodic software and firmware updates that enhance performance or fix problems. Software and firmware updates are provided free-of-charge under warranty and with a service agreement. Arcwave does not typically offer software and firmware updates outside of warranty or a service agreement so it is strongly recommended that customer's choose an annual service agreement.

Upgrades

Arcwave will also offer periodic software and firmware upgrades that provide additional product functionality. It is often the case that in order to implement the upgrade the customer's network must have software and firmware updated to the most current revision to operate properly.

Hardware Services

Warranty Repair and Return

If an item of Equipment malfunctions or fails in normal intended usage and maintenance within the applicable Warranty Period:

(a) The Customer shall promptly notify Arcwave of the problem and the serial number of the defective item;

(b) Arcwave shall, at its sole option, either resolve the problem over the telephone or provide the Customer with a Returned Materials Authorization number (RMA #) and the address of the location to which the Customer may ship the defective item;

(c) If the problem is not resolved over the telephone, the Customer shall attach a label to each returned item describing the fault and the Customer's return address. The Customer shall, at its cost, properly pack the item to be returned, prepay the insurance and shipping charges, and ship the item to the specified location;

(d) If the Arcwave product shall prove to be defective in material or workmanship upon examination by Arcwave, Arcwave shall either repair or replace the returned item at its sole option. The replacement item may be new or refurbished; if refurbished, it shall be equivalent in operation to new Equipment. Should a returned item be replaced by Arcwave, the Customer agrees that the returned item shall become the property of Arcwave.

(e) Arcwave shall ship the repaired item or replacement to the Customer's return address by carrier and method of delivery chosen by Arcwave at its cost. If Customer has requested some other form of conveyance, such as express shipping, then the Customer shall pay the cost of return shipment.

(f) Under no circumstances will Arcwave accept a return shipment without a properly assigned RMA #.

Out of Warranty Repair and Return

Out of warranty repairs and returns are subject to the same process as in-warranty repair and returns with the addition that upon receipt and evaluation of the product Arcwave will notify the customer in writing of the estimated cost of repairing the product or that the product cannot be repaired. In the former case the customer has the option to pay for the repair, request return of the product at their expense, or to purchase a replacement product. No credit is given for the defective product if a new product is purchased and the price of the replacement will be per the pricing in effect at the time of the order.

Spares

Arcwave will provide upon request a recommended list and minimum stocking quantities of spare parts for a customer's network or networks. Maintaining an adequate inventory of spare parts and completion of technical training is the most cost effective way to keep your network up and running.

As an incentive to purchase spare parts Arcwave will provide special discounts on spares when purchased with the network equipment. In addition customers who maintain an active service agreement with Arcwave also receive discounts on spare parts.

Training Services

ARCXtend System Planning, Installation & Maintenance Training Course

- Content: Covers planning, installation, configuration, and trouble shooting ARCXtend equipment
- Duration: 1 Day
- Format: Interactive Training Class with Lab
- Location: Campbell, Ca or Distributor Facility
- Price: Per current price list
- Expenses: For training at your facility add travel, lodging, and meal expenses for (1) trainer for (2) days.

Summary of Services

	In warranty		Out of Warranty	
	W/ Standard Service Agreement	W/O Standard Service Agreement	W/ Standard Service Agreement	W/O Standard Service Agreement
Technical Services				
Technical Assistance: Phone	24 x7 No Charge	24 x7 No Charge for 90	24 x7 No Charge	Hourly Rate charged in

and E-Mail		Days Receipt of Equipment Hourly Rate after 90 Days		1/10th of an hour increments. Payable in advance.
RMA Process	Access Available	Access Available	Access Available	Access Available
Documentation	Electronic Version Free with Product Purchase	Electronic Version Free with Product Purchase	Electronic Version Free with Product Purchase	Electronic Version Free with Product Purchase
Onsite Support	10% Discount	Daily Rate plus Travel & Lodging	10% Discount	Daily Rate plus Travel & Lodging
Emergency Support	10% Discount	Daily Rate plus Travel & Lodging	10% Discount	Daily Rate plus Travel & Lodging
Software/Firmware Services				
Updates	No Charge	No Charge	No Charge	As Quoted
Upgrades	Per Price List	Per Price List	Per Price List	Per Price List
Hardware Services				
Repair and Return	No Charge subject to warranty Terms and Conditions Return-to-factory response for the length of the warranty period, with 10 business-day turnaround from the date of receipt of the defective product at Arcwave. Expedited Shipping available at customer's expense.	No Charge subject to warranty Terms and Conditions Return-to-factory response for the length of the warranty period, with 10 business-day turnaround from the date of receipt of the defective product at Arcwave. Expedited Shipping available at customer's expense.	As Quoted Return-to-factory response for the length of the warranty period, with 10 business-day turnaround from the date of receipt of the defective product at Arcwave. Expedited Shipping available at customer's expense.	As Quoted Return-to-factory response for the length of the warranty period, with 10 business-day turnaround from the date of receipt of the defective product at Arcwave. Expedited Shipping available at customer's expense.
Spares	Special	Special	10% Discount	Per Price List

	discount available if part of initial order	discount available if part of initial order		
Training Services	15% Discount	Standard Rate	15% Discount	Std Discount

Table 8-1: Arcwave Service Offering Matrix

ARCWAVE ENTERPRISE MIB

This guide describes Arcwave Enterprise Management Information Base (Arcwave MIB) Release 2.0. 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 MIB Structure

The Arcwave MIB, named ArcwaveMib has the following structure:

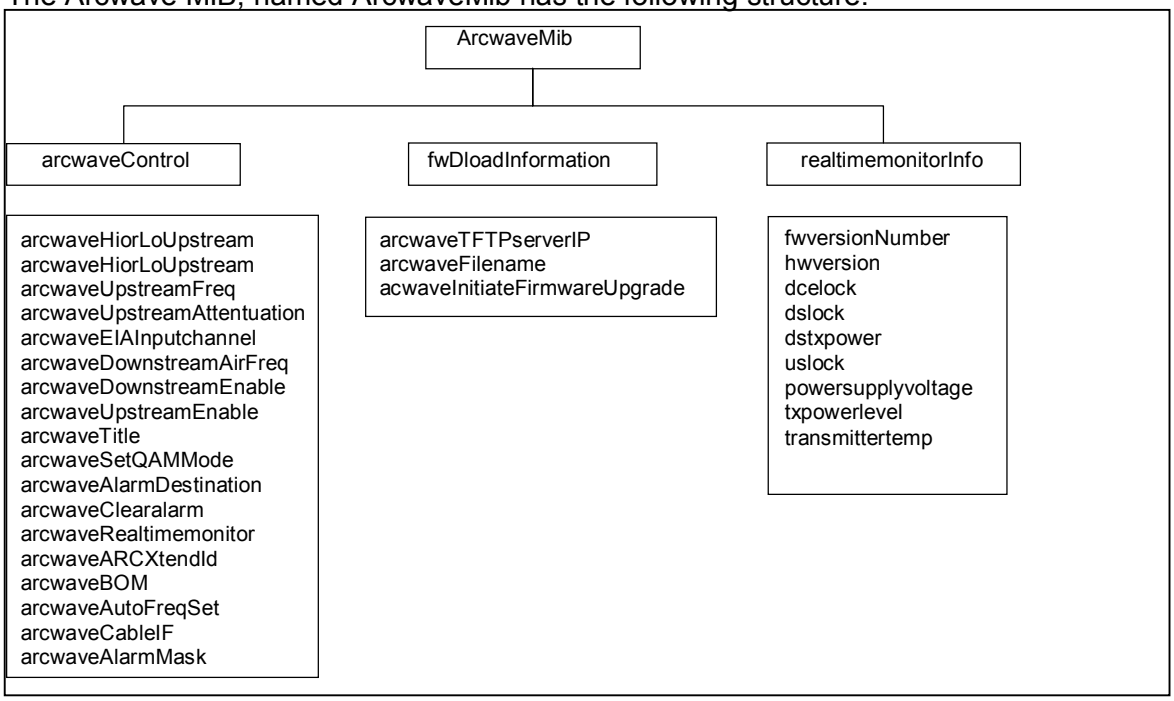


Figure A-1 Arcwave MIB

Arcwave 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						
arcwaveHiorLoUpstream	arcwaveControl 1	1.3.6.1.4.1.8595.1.12.1	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 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.	1 = High 2 = Low	Integer	Read/Write	Current	1
arcwaveUpstreamFreq	arcwaveControl 2	1.3.6.1.4.1.8595.1.12.2	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 AX1255 is 6.4 to 48 and for AX1455 is 10 to 48	Integer32	Read Only	Current	N/A

arcwaveUpstreamAttentuation	arcwaveControl 3	1.3.6.1.4.1.8595.1.12.3	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 reduces ingress noise onto the cable plant, but also decreasing the upstream wireless range.	0 to 64 (in dB) and 99. When set to 99, the gain will be set automatically	Integer32	Read/Write	Current	30dB
arcwaveEIAInputchannel	arcwaveControl 4	1.3.6.1.4.1.8595.1.12.4	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
arcwaveDownstreamAirFreq	arcwaveControl 5	1.3.6.1.4.1.8595.1.12.5	This element sets the downstream wireless channel to be used. (in MHz)	For AX1255: 5729 5735 5741 5747 5759 5765 5771 5777 5783 5789 5795 5807 5813 5819 5825 5831 5837 5843 For AX1455: 5819 5825 5831 5837 5843 5849 5855 5861 5867 5873	Integer32	Read/Write	Current	
arcwaveDownstreamEnable	arcwaveControl 6	1.3.6.1.4.1.8595.1.12.6	This element turns on the downstream wireless transmitter in the Hub.	1 = true 2 = false	Integer	Read/Write	Current	2

arcwaveUpstreamEnable	arcwaveControl 7	1.3.6.1.4.1.8595.1.12.7	This element turns on the upstream wireless receiver in the Hub.	1 = true 2 = false		Read/Write	Current	2
arcwaveTitle	arcwaveControl 8	1.3.6.1.4.1.8595.1.12.8	This element can be used to assign a Hub name.	40 character alpha numeric string	SnmpAdminString	Read/Write	Current	MAC address of ECM
arcwaveSetQAMMode	arcwaveControl 9	1.3.6.1.4.1.8595.1.12.9	This element selects the Downstream Power Setting: If “High” is selected, the transmit power is set to 19 dBm. (For use with AX1255-VM-90 and AX1255-SM-90 Hubs only.) If “Medium” is selected, the transmit power is set to 13 dBm. If “Test” is selected, the transmit power is set to 3 dBm.	0 = High 1 = Low 3 = Test	Integer	Read/Write	Current	1
arcwaveAlarmDestination	arcwaveControl 10	1.3.6.1.4.1.8595.1.12.10	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	
arcwaveClearalarm	arcwaveControl 11	1.3.6.1.4.1.8595.1.12.11	Clears alarms	1 = true 2 = false	Integer	Read/Write	Current	2
arcwaveRealtimemonitor	arcwaveControl 12	1.3.6.1.4.1.8595.1.12.12	Fetches Real Time Monitoring information from the ArcXtend Hub	1 = true 2 = false	Integer	Read/Write	Current	2
arcwaveARCXtendId	arcwaveControl 13	1.3.6.1.4.1.8595.1.12.13	This element indicates the ARCXtend Hub type.	01 = AX1255 02 – AX1455	Integer	Read Only	Current	01
arcwaveBOM	arcwaveControl 14	1.3.6.1.4.1.8595.1.12.14	This element turns PureBurst ingress noise suppression on or off	0 = Off 1 = On	Integer	Read/Write	Current	1
arcwaveAutoFreqSet	arcwaveControl 15	1.3.6.1.4.1.8595.1.12.15	This element enables or disables the automatic setting of arcwaveEIAInputchannel and	0 = disable 1 = enable	Integer	Read/Write	Current	1

			arcwaveUpstreamFreq.					
arcwaveCableIF	arcwaveControl 16	1.3.6.1.4.1.8595.1.12.16	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 = On 1 = Off	Integer	Read/Write	Current	0
arcwaveAlarmMask	arcwaveControl 17	1.3.6.1.4.1.8595.1.12.17	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
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	
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	255a
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	2
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	255a
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	255a
dcelock	realtimemonitorInfo 3	1.3.6.1.4.1.8595.1.15.3	This element indicates the state of the Hub downstream DOCSIS channel tuner. A"true" will be displayed if the Hub is tuned to a channel.	1 = true 2 = false	Integer	Read/Write	Current	2
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	2

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	
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	
txpowerlevel	realtimemonitorInfo 8	1.3.6.1.4.1.8595.1.15.8	This element reports the approximate upstream transmit power level of the hub. Its value is the upstream transmit power level of the ECM- 10). (in dBmv)	0 to 99	Integer	Read-Only	Current	
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	

Table A-1 Arcwave MIB Definitions and OID

Arcwave Alarm Descriptions

Line #	Alarm Syntax	Alarm Message Text	Alarm Severity	Customer Symptom	Explanation of event / Corrective Action	What will the Customer Experience
1	AR300 System Lock Lost	The Unit has lost lock in the Upstream or Downstream	Critical	Modems on the ARCXtend system lose sync	Clear alarms and/or reset power on unit & check if condition goes away	Lost of traffic, system outage
2	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
3	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.
4	AR300 Downstream (Transmitter) Over Temperature	The Unit is operating above Max. operating temperature	Major	This alarm gets displayed	The Unit is operating above Max. operating temperature/ Check operating temperature, clear alarm & switch the unit off if condition does not go away.	No immediate impact but could result in loss of traffic, system outage.
5	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
6	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
7	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
8	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	Downstream (Transmitter) Over 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

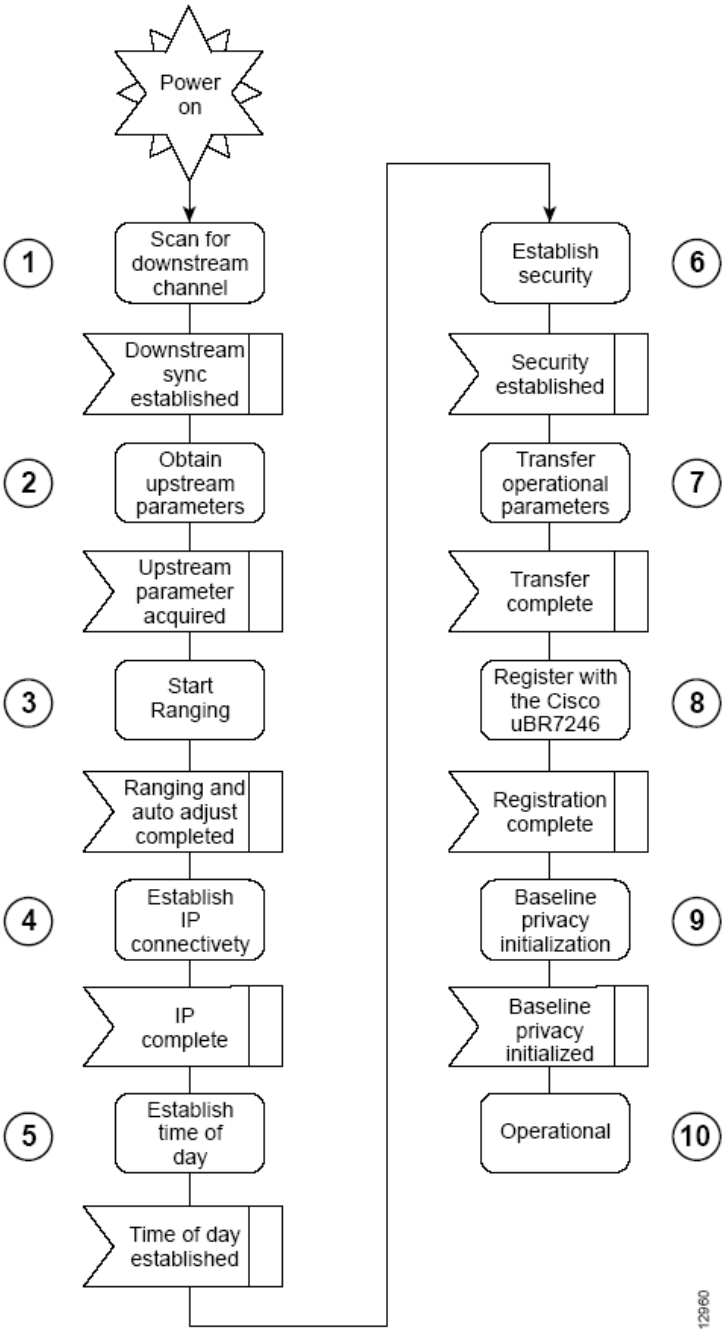
arcwaveEIAInputchannel VALUES

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

Table A-4
arcwaveEIAInput
channel Values

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